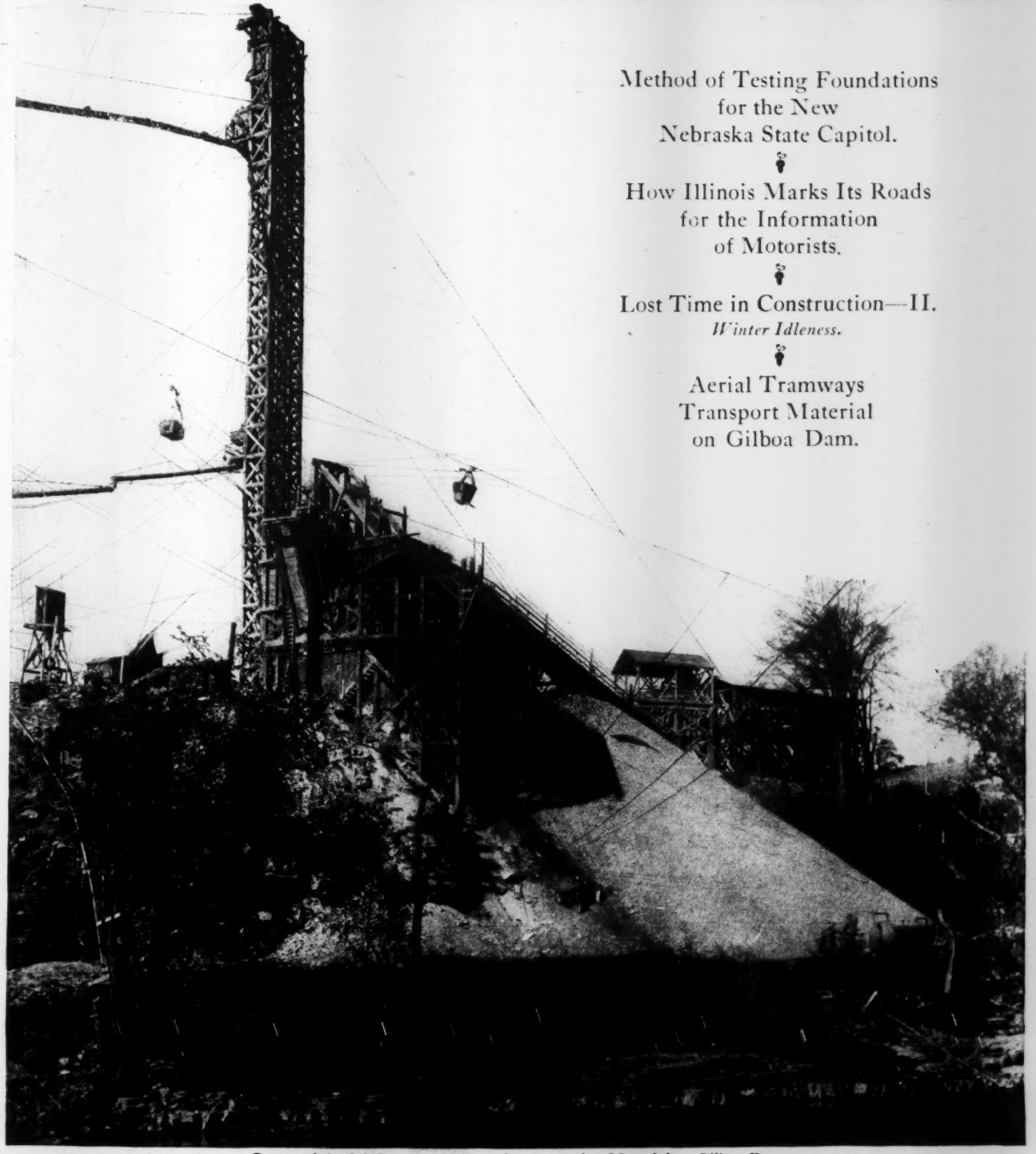
Engineering
Library

Devoted to Civil Engineering and Contracting. McGraw-Hill Company, Inc.

October 12, 1922

Engineering News-Record



Method of Testing Foundations for the New Nebraska State Capitol.

How Illinois Marks Its Roads for the Information of Motorists.

Lost Time in Construction—II.
Winter Idleness.

Aerial Tramways Transport Material on Gilboa Dam.

Center of Aerial Tramway System for Conveying Material at Gilboa Dam

KREOLITE

List everything your factory floor *should* be, then see how completely Kreolite Floors meet *every* need.

And, you will be free from the floor troubles and expenses of the past, because:

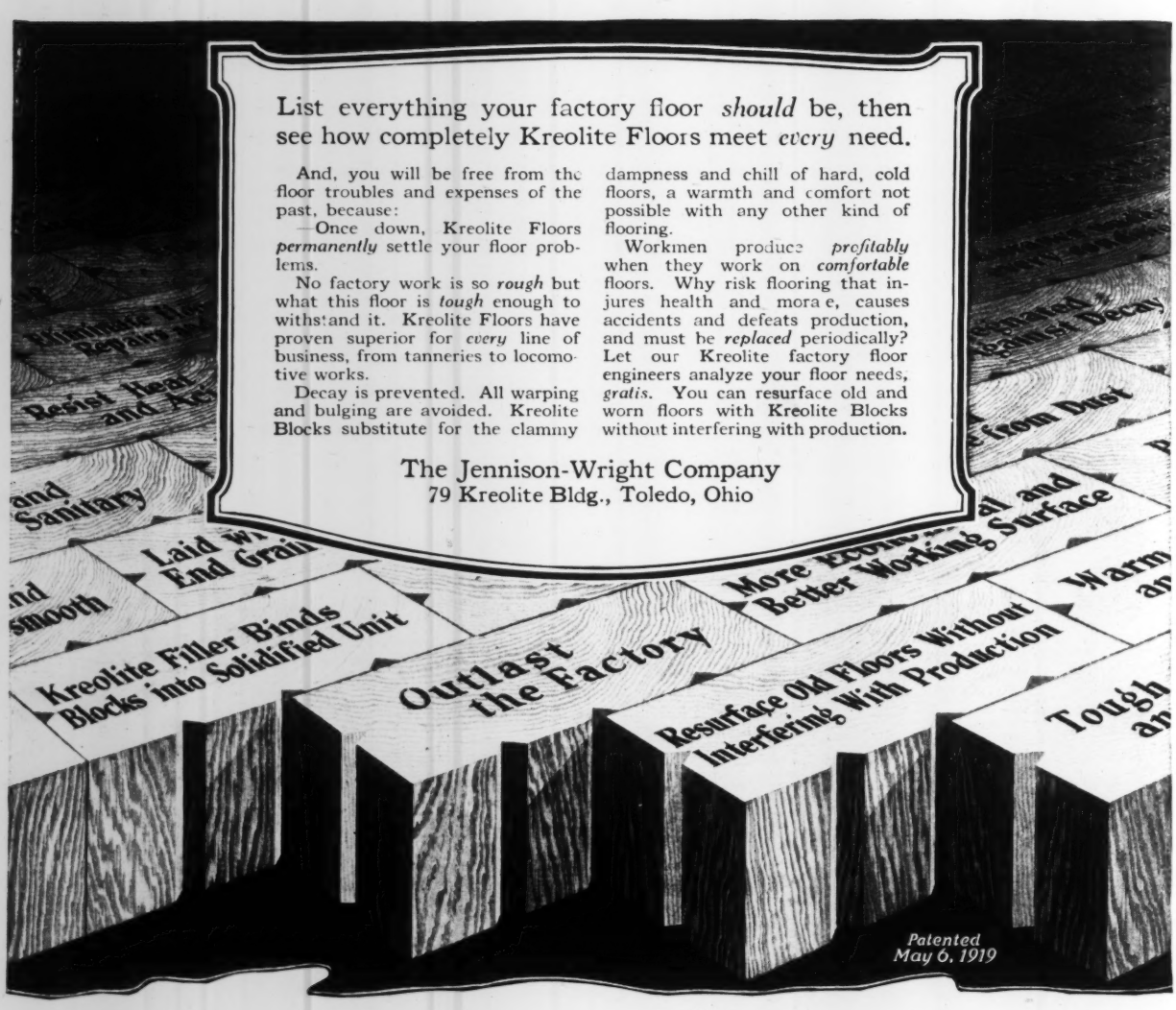
—Once down, Kreolite Floors *permanently* settle your floor problems.

No factory work is so *rough* but what this floor is *tough* enough to withstand it. Kreolite Floors have proven superior for *every* line of business, from tanneries to locomotive works.

Decay is prevented. All warping and bulging are avoided. Kreolite Blocks substitute for the clammy dampness and chill of hard, cold floors, a warmth and comfort not possible with any other kind of flooring.

Workmen produce *profitably* when they work on *comfortable* floors. Why risk flooring that injures health and morale, causes accidents and defeats production, and must be *replaced* periodically? Let our Kreolite factory floor engineers analyze your floor needs, *gratis*. You can resurface old and worn floors with Kreolite Blocks without interfering with production.

The Jennison-Wright Company
79 Kreolite Bldg., Toledo, Ohio


Kreolite Filler Binds Blocks into Solidified Unit
Outlast the Factory
Resurface Old Floors Without Interfering With Production
Patented May 6, 1919

FLOORS

WOOD BLOCK

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—JAMES H. McGRAW, *President*

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN
Editor

Volume 89 — NEW YORK, OCTOBER 12, 1922 — Number 15

Making Specifications in Societies

EXCEPT for a most unbalanced program, last week's meeting of the American Society for Municipal Improvements was a marked success. Even if it could not have been foreseen that the dozen specification committee reports scheduled for a single session would have been disposed of in an hour and a half it was evident to all that the group of eight or ten papers and reports on sewage treatment listed for Thursday morning would be far too many for even the four hours to which the session was stretched. The perfunctory way in which the specification reports were received and acted on raises the question of procedure common to every specification-making society. How far should the program be cluttered up, the members bored and time wasted in presenting to a convention specifications which have to go to letter ballot for approval. Academically the practice of open meeting presentation is admirable; practically not one specification out of a hundred is ever rejected on the floor and when one is altered the chances are great that the alteration is ill-considered and dangerous.

Why Separate Sewers?

THE abuses to which both sanitary and storm sewers are commonly subjected were so forcibly shown by H. P. Eddy at the A.S.M.I. convention last week as to raise the question whether separate sewers are advisable. The full strength of the case made by Mr. Eddy cannot be presented in our necessarily rather short abstract of his full and able discussion. One thing is certain. If separate sewerage systems are to be continued, municipal authorities must awake to the necessity for rigid safeguards against the various abuses to which they are subjected, especially the prevention of overcharging sanitary sewers by permitted or surreptitious storm-water connections and like connections of house sewers with storm-water drains.

Relating Geology to Engineering Work

IN THE course of the discussion of the paper on "Engineering Geology of the Catskill Water Supply," presented to the American Society of Civil Engineers at its last meeting by Prof. Charles P. Berkey and James F. Sanborn, it transpired that several requests have reached the authors for copies of the paper to supplement courses in geology in technical schools. This indicates that the paper makes further progress along a road already staked out by Professor Berkey in earlier publications; namely, the presentation of geology as a practical tool of the engineer, rather than as an isolated department of science. Geology is not the only subject that suffers at the hands of the engineering undergraduate because of his failure to appreciate its utility. Neither is it the only subject that can be made live and interesting by an instructor with the capacity to interpret its significance in terms of engineering construction. Some teachers have this capacity, and their graduates take away with them a sound fundamental grasp of the subject and its relation to the work they have to do, rather than a confused and fugitive recollection of abstract science and unrelated information. This paper is a noteworthy contribution toward the breathing of life and purpose into one of those collateral subjects which are required of engineering students but which all too often are considered only as hurdles to be overcome in the pursuit of an engineering degree.

Getting Back to Earth

IN THE formulation of agreements between the railroad companies and the new company shopcrafts unions considerable progress is being made toward the elimination of some of the more objectionable inheritances from the régime of government operation. A most gratifying step is the restoration of piece work on some of the roads. So long as fair standards of performance can be established and are maintained, there is no reason why compensation cannot be made proportionate to the work performed. There is every reason, moreover, why such method should do greater justice to both employer and employee than the payment of a uniform wage which inevitably tends toward uniformity of production. Other incentives may be more deep seated and more elemental, but none is more direct or quick acting than that of having increased efficiency and increased industry reflected in the next pay envelope. And if there ever was a time when industry and efficiency are needed in the railway shops of the country it is today.

Prolonging His Reign

SMALL encouragement for the public will be found in the announcement that the United Mine Workers are planning to demand, for another two years, beginning next spring, a continuance of the existing wartime wage scale, together with the establishment of a 6-hr. day and a five-day week with time and a half for overtime. The negotiations between the miners and the operators will be held next January, but the impression prevails that insistence by the miners upon these demands can result only in another struggle such as that recently ended. Already the operators announce their intention of calling a meeting to form a permanent national association "to deal with labor problems." Operators and miners both have demonstrated their incompetence to "deal with labor problems" in any manner that can make for the public welfare and the sooner the government commission recently authorized can be put to work, the better it will be for all concerned. The American people cannot afford to put up with another disturbance like the recent strike. There is no reason,

moreover, why they should be asked to put up with it, and it is incumbent on governmental authority to see that they are not required to put up with it. In commenting on the recent settlement we pointed out that 750,000 coal miners had imposed their will upon the 24,000,000 farmers and wage earners of the United States and that King Lewis had declared his superiority to economic law. At that time we asked whether he was to be merely king for a day. Should he succeed in carrying out his present plans he will have strengthened his grip upon the scepter for at least two years longer.

Major General Sir Henry Thornton

EIGHT years ago last February *Engineering News* recorded the appointment of Henry W. Thornton, general superintendent of the Long Island R.R., as general manager of the Great Eastern Ry., the largest system in the British Isles. Now, Major General Sir Henry Thornton is returning to this side of the ocean to head the reorganized Canadian National Railway system. He took with him to England an engineering training in an American university and an experience of twenty years in the engineering and operating departments of the Pennsylvania R.R. He returns full of honors that attest how effectively he has mastered the problems of British railroading and commanded the confidence of the British public. If background is worth anything at all in his new work General Thornton should command a peculiar advantage, combining as he does an intimate knowledge of American railroad practice with a British viewpoint that will be most helpful in directing the national railway system of one of the most loyal dominions of that great empire.

Possibilities in Port Control

THOSE residents of New York City who still feel that the organization of the interstate Port Authority was a usurpation of the city's natural and legal rights would do well to ponder the following nonpartisan sentences from Elihu Root's recent political address before the state Republican convention:

> The harbor of New York is one of the chief assets of our state and of our nation. Nobody can take that asset away merely by making a residence in the vicinity. If the port of New York were to cease to perform its primary function as the gateway of the nation's commerce, and the flow of commerce were to cease, the inhabitants of the city must disperse and go elsewhere in search of food and occupation. The people living in that territory are the keepers of the gate for the nation. They constitute a part of a great national organization of production and trade. Upon the continued and prosperous working of that organization as a whole depend the prosperity and the lives of all the people of the state, which is sovereign over the territory about the Bay of New York where powers have been vested in the people of the city of New York as agents of the state.

If those who regard the harbor as the city's private property can vizualize an extension of this thought by an equally lucid legal mind pleading before a court or Congress or the federal administration, they can readily see how a restricted and mercenary municipal port policy might lead to that federal assumption of port control which has been frequently predicted but which has never been taken seriously by the selfish interests in the city.

Sage Counsel on Business Problems

HEARTENING as a friendly light on a storm-tossed horizon is the counsel of Thomas W. Lamont to the American Bankers' Association at its annual convention in New York last week. Hope and confidence are derived from his analysis of current economic conditions because of its sanity, its fairness, and its freedom from the traditional cant so often invoked on like occasions. Mr. Lamont is a disciple neither of Pollyanna nor of Jeremiah. He sees improvement, but he warns that several obstacles still encumber the road to prosperity.

With regard to labor problems, Mr. Lamont reminds his hearers of the responsibility that rests upon them. He bids them remember that there are still traces of arrogance in employers as well as in employed. The latter he attributes largely to the "boom wages" of the "boom years," which "gave labor the feeling that it must always share in the prosperity, never in the adversity, of business. I deplore that feeling," continued Mr. Lamont," yet I beg to remind you here that that feeling of labor, in so far as it was directed to the improvement of living conditions, to the gaining of a little leisure and of the time to play and be happy, was wholly right and to the advantage of the community. From such men as you such ambitions on the part of labor, moderately and wisely directed, should have every possible encouragement.

"The problem of capital and of labor will never be wholly worked out. People talk as if it were an example in arithmetic, capable of a final solution. It is no such thing. It is a problem of human beings: therefore, of emotions, gropings, longings, and ambitions. We can meet it only little by little, and only then if we put ourselves in the other fellow's shoes and get his viewpoint. . . . It is our responsibility to study more fully than we do today the conditions of labor and to be sure that, by and large, every competent worker (be he in the office or in the field) has an interval in the drudgery of work for that enjoyment of life that will make him a more contented and better citizen. In this matter you and I have a responsibility that we cannot dodge."

In discussing the human problems of industry three viewpoints are commonly taken: That of the Bourbon, who learns nothing and forgets nothing; that of the sentimentalist, blind to fact and experience and taking counsel only of his hopes and ideals; and finally that of the genuine progressive, keenly alive to the lessons of yesterday and determined to apply them to the problems of today in such wise that tomorrow shall see us a little farther along the road to economic efficiency and social justice. This last is the viewpoint so happily set forth by Mr. Lamont in the foregoing extract.

Low prices, caused largely by plentiful crops, do not worry Mr. Lamont, who contends that no country ever went broke on abundance of crops and that in the long run the farmers, like the rest of us, "will fare better on a moderate price scale with small fluctuations." He warns against a tariff policy that forgets the mutual character of trade and reminds us that "he who does not buy, neither shall he sell." Europe he considers to be on the mend, with hope for the future centered not in the formulas of statesmen, economists, or bankers so much as in the hard work and the thrift of the people —coupled with wise and courageous leadership.

This noteworthy summary, so broad in its scope, so sane in its judgments, and so stimulating in its reasoned optimism, deserves a wide circulation. If in this comment we have dwelt upon its expression concerning the relations between employer and employee, it is because of the fundamental quality of those relations, and because of a conviction that if Mr. Lamont succeeds in winning to his viewpoint on that question the influential audience he was addressing, a great work for industrial good-will will have been achieved.

A Professional Obligation

A READER brings to our attention a condition that one might prefer to forget about as something regrettable that cannot well be helped. He complains that the published records of engineering work are sadly incomplete, and that in particular the trials and failures which form part of every record of construction are commonly omitted.

To use his own words: "Any one who has had occasion to search through the records of a particular branch of engineering soon finds that much valuable information is frequently omitted in work described, and that many important works are left without any published records. The information that is published usually covers only the favorable results obtained, and rarely mentions the unfavorable ones. Yet hardly an engineering work is carried through without some unsuccessful attempts being made somewhere; if these were generally recorded and published, not only the engineers directly connected with the work, but also other engineers, might learn to avoid them in the future. As it is, the experience and knowledge gained in these attempts are lost to the engineering profession at large."

These few words carry a strong appeal. We are hopeful enough to believe that every reader will appreciate its force. We believe, moreover, that many an engineer preparing a paper on a piece of work accomplished feels it is his duty to tell a complete story, and that he will omit the most valuable portion of the record if he tells only of the successes. Yet many important engineering occurrences are withheld from record, and quite commonly published descriptions omit valuable experiences that are not flattering to those in charge.

There are readily understandable causes back of this condition. The engineer is not always free to tell all the details, at least the unpleasant details, of a case involving other interests than his own. His clients and his associates in the work, contractors and engineers, architects, even manufacturers who supply material or equipment, have feelings and prejudices—possibly rights—that claim consideration.

Not always do reasons of this kind control, however. The personal pride of the engineer is often the governing factor; to speak plainly, he wishes to present himself only in a favorable light.

The evil may to some degree be a necessary one, the resultant of the multiplicity of human factors that attend engineering work. Yet it is certain that the professional conscience, both individual and collective, will always stand squarely against the tendency to paint in fair colors only and to omit essential but uncomfortable bits of truth. Every individual student of engineering records resents the unfair task imposed on him of having to read between the lines and finding there nothing but white paper. We hope that in the course of time this feeling will crystallize into openly expressed convictions of the whole profession, which will demand more complete recording of engineering experience. In view of the human factors involved one might think that such a hope was futile. But a general professional conviction will hearten the engineer who inclines to tell the full history of an engineering work; and professional approval of his contribution to the knowledge of the art will more than balance the fault-finding and criticism—unless there be almost criminal dereliction and incompetence.

A basic professional obligation is involved in making true records of engineering work.

A Question of Language

TRANSMISSION of thought by drawings is one of the defining characteristics of modern engineering, so important a one, indeed, that the engineer may fairly be described as a man who talks with drawings. Drawing is the language by which he conveys his meaning in very many of his dealings with other men. He has acquired great skill in using this special language, and, as we all know, can apply it with wonderful precision. Yet, if some recent observations mean anything, he often fails to use it clearly, or even intelligibly. During the last few weeks we have been interested to notice that among the many drawings, original and printed, which come to an editorial office there is a significant number whose meaning is obscure, confused, or quite unintelligible.

Thus, to cite a few specific instances, beginning with a mild case: In the drawings of a novel structure now being built, views of detail parts which appeared on several sheets lacked both title and reference lines, leaving the location of these parts to be guessed at, with the result that the user of the drawings, instead of reading them directly, had to solve a riddle A paper which gave an analysis of some newly studied mechanical actions of great interest to structural men presented its essential facts by various curve diagrams; these diagrams had no adequate legends or captions, and as in addition their ordinate values were not defined they confused more than they informed, and the author of the work largely failed in his effort to transmit the message he intended to deliver. One of the leading investigations of the last few years in the civil engineering field is reported by a short text statement supplemented by a dozen or more diagrams so bare of information as to their meaning, interrelation, or method of derivation that nine out of ten readers of the report are morally sure to get nothing whatever out of it.

Such shortcomings in drawings—and we find that they are disconcertingly numerous—mean simply that gross misuse of language has been committed, a misuse which, if paralleled in ordinary written language, would dishonor and defame its author. Are our ideals too low or too vague where applied to the language of graphic representation to enforce even the mimimum standards that would insure clarity? Or do our schools miss one of their functions, when they insist upon grammatical and effective expression with the pen but ignore corresponding needs in the art of the pencil? This much may be set down as an axiom: Unintelligible use of any language is wasted effort, just as truly in the language of drawing as in any other.

Marking System for Illinois State Roads

Danger and Caution Signs Developed by Tests on 60-Mile Stretch and Covering Several Months—Special Route Marking Through Cities Gives Satisfaction

By Ralph R. Benedict
Assistant Chief Highway Engineer, Springfield, Ill.

TWO requirements of road marking were had principally in mind in developing the system recently adopted for the State of Illinois. They were:

1. To make the highways as safe as possible under present-day traffic conditions.

2. To impart as complete directory information to the traveling public as may be feasible.

Warning and Danger Signs—To accomplish the first purpose, wooden signs, 42 in. wide and 24 in. high, with black letters on a white background, are erected. These signs, which are located 400 ft. each way from every point of potential danger, are carried on 4 x 4-in. creosoted wooden posts, set 15 ft. from the center of the pavement on the right-hand side; the bottom edge of the sign being 4 ft. above the pavement.

On all side roads and cross roads connecting with the improved state roads, the signs read: "Danger—State Road." The word "Danger" is painted red on a white background, the letters being 7 in. high and 4½ in. wide. The words "State Road" are painted black, the letters being 5 in. high and 2½ in. wide. (Fig. 1.) On the paved roads the signs read: "Look"; "Caution"; or "Danger"; depending upon the location.

"Look" signs are erected where the driver need not slacken speed but should be on his guard.

"Caution" signs are erected where some slacking of speed and a certain degree of care are necessary.

"Danger" signs are used only where there is imminent danger, i.e., where extra precaution must be taken and speed greatly reduced.

The letters in the words "Look" and "Caution" are 7 in. high and are painted black on a white background. The letters in the word "Danger" are the same height as in the words "Look" and "Caution" but are painted red on a white background. Beneath these words, in letters 5 in. high and 2½ in. wide, the nature of the danger is indicated, i.e., "Sharp Curve R" (sharp curve right); "Cross Road"; "Side Road"; "S Curve L" (reverse curve left); "School"; "Narrow Bridge," etc. (Fig. 2).

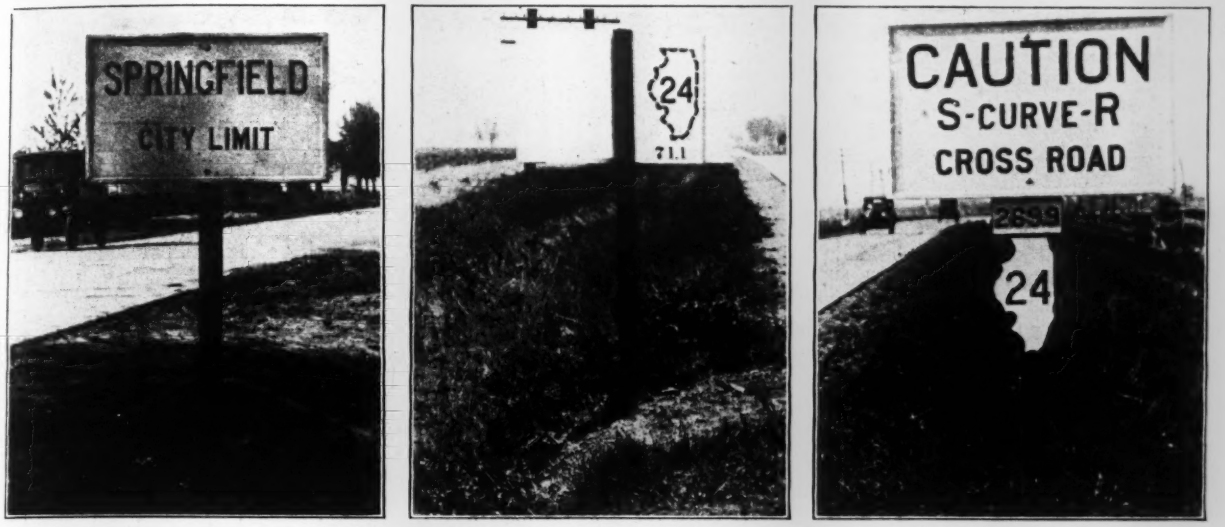
Where continuous care for a certain distance is necessary because of the frequency of cross roads, curves, narrow bridges, schools, etc., "Caution Zones" have been established. Such zones are marked at each end with a board sign lettered "Caution Zones." (Fig. 3.) These signs have a border of diagonal black and white stripes approximately 2 in. wide. Throughout the caution zone all poles, bridge rails, other stationary objects, and, where necessary, special posts near the feature of potential danger, are painted with diagonal black and white stripes; in this way a great number of confusing separate signs are avoided.

System Carefully Studied—Before the final adoption of this system of warning signs, a 60-mile stretch of road was fitted with signs and studied for a period of several months. This study resulted in a number of minor modifications. At first the signs were so erected that the line of sight of a driver when 200 ft. away was perpendicular to the plane of the sign board. It was found that the painted surface being glossy caused a reflection of the headlights at night so that the lettering could not be read conveniently, until the driver had approached to within 50 ft. of the sign. On the other hand, the very fact that this reflection occurred made the sign very conspicuous at distances even as great as one-half mile under favorable conditions. In order, however, that the legend might be more readily deciphered at greater distances, the sign boards are now set normal to the center line of the road. At this angle the signs are still very conspicuous at distances of 1,000 ft. or more; and the lettering may be read at night at distances of from 50 to 100 ft.

FIGS. 1, 2 AND 3—CAUTION AND DANGER SIGNS ON ILLINOIS STATE ROADS

Direction Signs—To furnish directory information to the traveling public—the following system has been adopted:

First: At the corporate limit of each city and vil-



FIGS. 4, 5 AND 6—DIRECTION AND DISTANCE SIGNS ON ILLINOIS STATE ROADS

lage, a sign board of the same size as those carrying the warning signs is erected. The name of the city and the words "City Limit" appear on that side of the sign faced by the traveler when approaching the city. (See Fig. 4.)

At the corporate limit there is erected, on the right hand side of the road as the traveler leaves the city, a sign on which is lettered the name of the next town and the distance thereto; also the name of the next principal objective point on the route and the distance thereto.

Second: All State routes are numbered. The back of each warning sign carries this number. On these signs the borders of the State are outlined in black; and within this outline the route number appears in black numerals 5¾ in. high. Inasmuch as two warning signs are erected at each cross road and each side road on the state system of highways, the traveler is advised at frequent intervals of the number of the route on which he is traveling.

In addition to the route number, by means of red numerals, the distance along the route from its northerly or easterly terminus is noted on each rural warning sign in miles and tenths of miles. (See Fig. 5.)

At all cross roads and side roads leading to near-by cities and villages, an aluminum plate appears just below the sign board. On this aluminum plate the State borders are outlined, with the route number in raised black numerals and the mileage in raised red numerals. (Fig. 6.)

The final scheme contemplates showing on a complete road map of the state not only the route numbers but the mileage numbers of each important intersecting road, which is marked by an aluminum sign. This enables a traveler at any intersecting road to check his exact location by comparing both the route number and the mileage number of the intersection with those indicated on the map. The map, however, will not be available for some months.

The following are illustrations of the use of this marking system:

1. Assume that a traveler desires to start from Chicago, having Chillicothe in Peoria County as his objective. An examination of his map would show that he should follow Route 4 from Chicago to Joliet; Route

FIGS. 7, 8 AND 9—ROUTE SIGNS THROUGH CITIES ON ILLINOIS STATE ROADS

7 from Joliet to Depue and Route 29 from Depue to Chillicothe. If he is a stranger, the city limit sign, as he enters Chillicothe, will advise him that he has reached his destination.

2. Assume that a traveler desires to start from East St. Louis, having Delavan in Tazewell County as his objective. An examination of his map would show that Delavan lies about 4½ miles east of State Route 24; and, further, that the red mile number of the cross road leading to Delavan is 25.9. Without references to the map thereafter, the traveler could hold in mind that he should follow Route 4 from East St. Louis to Springfield; Route 24 from Springfield to the cross road on which the mileage number (25.9) appears all he has to do then is turn east and drive approximately 4½ miles to Delavan.

Marking Through Cities—No warning or danger signs appear within the corporate limits of cities and villages; therefore aluminum markers, showing the route number and the mileage (even miles only) erected on independent posts are used at street intersections to direct traffic.

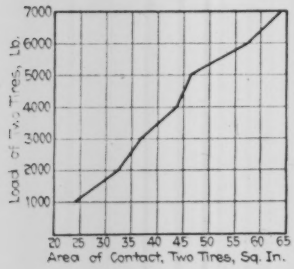
Three different patterns are in use for the city markers, all of which have in common a double-faced flat plate (approximately 22½ in. high by 11 in. wide) showing the State outline in black and the route number in raised black numerals. At turns, an arrow pointing in the proper direction appears above the standard plate. At even miles, the mileage number in raised red figures appears at the top of the plate. At other intersections the plate embodies no special features.

One or the other of these designs is erected at each paved intersection on the far side of the intersecting street. (See Figs. 7, 8, and 9.)

The erection of these markers on independent posts, always approximately at the same position relative to the street intersections, undoubtedly will prove more satisfactory as a guide through cities than where telephone poles or other objects are used, the location of which is not always favorable for the proper guidance of traffic.

Pressure Intensity of Truck Tires on Asphalt Tested at Detroit

TO DETERMINE the concentration of loads on motor truck tires and its relation to the compressive strength of asphalt pavements the city of Detroit has been conducting tests under the direction of J. C. McCabe, research engineer. In the table and curves herewith, are presented the results obtained by applying loads of from 1,000 to 7,000 lb., in 1,000-lb. increments to a Clark diskwheel equipped with dual 36x5-in. Goodyear cushion tires. The weight of a wheel and tire was 570 lb. For a *single* tire (dividing by 2) the load applications were equivalent to a range of from 500 to 3,500 lb. The manufacturer's maximum rating was 2,000 lb.

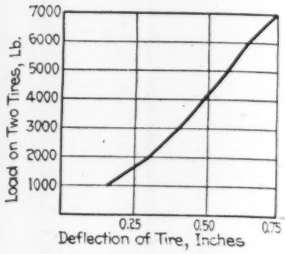


AREA OF TIRE CONTACT UNDER DIFFERENT LOADS

Under a total load of 5,000 lb., or 2,500 lb. on each tire, which was 25 per cent over the rated maximum, a maximum pressure intensity of 135 lb. per square inch was recorded. Compression tests of asphalt paving mixture samples made in conjunction with the tire tests showed that the yield point was reached at 116.6 lb. per square inch at 150 deg. F. In other asphalt tests the yield point has been reached at 100 lb. per square inch at 150 deg. F., a temperature which Mr. McCabe has found to exist in pavements during midsummer.

RESULTS OF LOAD TESTS ON 36 X 5-IN. DUAL CUSHION TIRES

Load on Two Tires, Lb.	Deflection, In.	Contact Area (Two Tires), Sq. In.	Max. Load Per Lin. Inch, Lb.	Max. Load Per Sq. In., Lb.
1000	0.162	23.6	120	50.5
2000	0.300	32.4	198	74.8
3000	0.402	36.8	255	92.7
4000	0.483	43.8	310	107.4
5000	0.568	46.4	402	135.0
6000	0.640	57.8	509	150.0
7000	0.751	64.0	555	157.0



RANGE OF DEFLECTION OF TIRE

Studies of Flow Through Cleared and Uncleared Floodways

Mid-Course Gagings—Velocities Taken by Current Meter from Boat—Difference in Discharge Capacity 62½ Per Cent

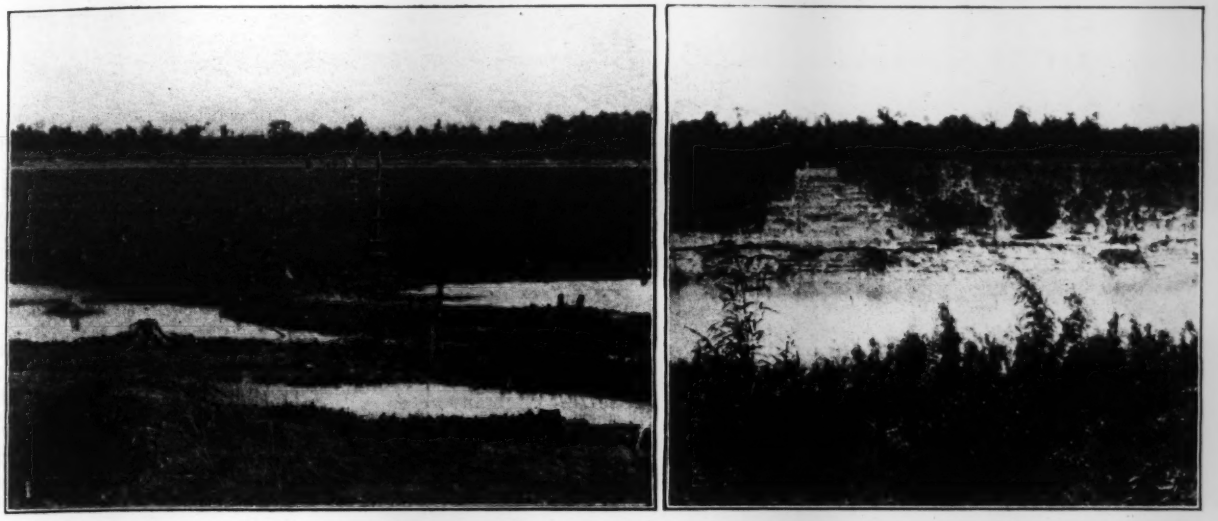
BY CHARLES E. RAMSER
Senior Drainage Engineer, U. S. Department of Agriculture, Washington, D. C.

ALTHOUGH the use of the floodway, as a device for preventing overflow of land by streams, is quite common, little information is available upon which the engineer can rely in the design of such structures. In November, 1921, investigations were begun by the United States Department of Agriculture in the Little River Drainage District, south of Cape Girardeau, Mo., for the purpose of securing such data.

The diversion floodway of the Little River Drainage District is about 32 miles long. It extends from a point near Greenbier, Mo., along the border of the foot hills of the Ozarks in an easterly direction to the Mississippi River. It collects all the water from the streams emerging from the foothills to the north, and by the shortest route conducts it to the Mississippi River.

Since the beginning of these investigations there have occurred no general heavy rains to produce high rates of runoff in the floodway, but an ordinary general rain in combination with a high stage in the Mississippi River produced a measurable flow in the floodway, the maximum depth of which was about 5½ ft. Thus an opportunity was afforded for the determination of the rate at which the water could be removed by the floodway; or in other words for the determination of the value of n in Kutter's formula—the one most generally used in computing the discharge of a floodway.

These experiments were conducted on a straight section of the floodway about 2½ miles in length near Nash, Mo. Two courses of 3,000 ft. each were selected along this straight section, one of which was cleared of all growth and obstructions except stumps for 500 ft. above and below the ends of the course and the other was left



FIGS. 1 AND 2—CLEARED AND UNCLEARED FLOODWAYS, LITTLE RIVER DRAINAGE DISTRICT, MISSOURI

In (1) the trees and brush were cut from the entire floodway, but in (2) they were not cut. In each boat-gaging station or course the stumps were cut even with the ground for a width of 10 ft. to prevent interference with the current meter, and in the boat course in the uncleared floodway (2) all growth was cut from a strip 40 ft. wide. The boat was attached to a 1¼-in. guide wire, supported on poles, in each case; the poles show in Fig. 1.

uncleared below the lower end of the course and for 500 ft. above the upper end.

The floodway lies between parallel levees, the distance from center to center of levees being 1,120 ft. The north levee is about 14½ ft. in height and the south levee about 18 ft. The dimensions of the main channel in the floodway are about as follows: Top width, 145 ft.; bottom width, 60 ft.; depth, 20 ft.

To eliminate the accelerating influence of the high velocities in the main channel upon the flow in the floodway, the boundary of the floodway was taken at about 30 ft. from the edge of the channel.

In the table are given the hydraulic elements and values of n in Kutter's formula as obtained for the cleared and uncleared courses of the floodway respectively. Four measurements were made on the cleared course for average depths in the floodway ranging from 4.4 to 5.5 ft., and three measurements on the uncleared course for average depths ranging from 4.5 to 4.9 ft. The average value of n obtained for the cleared course is 0.0465 and for the uncleared, 0.0777. The condition of the two courses as regards stumps was practically the same so that the differences in the values of n obtained may be attributed to the growth permitted in the floodway. To determine the probable relative efficiency in terms of discharge for the uncleared course in its present condition and after it has been cleared, computations for discharge were made using $n = 0.047$, the value obtained for the cleared course on April 2, and using the hydraulic elements as obtained for the uncleared course on April 2 when n was found to be 0.079. The computations show a difference in discharge capacity of 62½ per cent.

HYDRAULIC ELEMENTS AND VALUES OF n IN KUTTER'S FORMULA FOR CLEARED AND UNCLEARED FLOODWAYS

Date	Mean Gage Height	Average Depth Ft.	Average Surface Width Ft.	Discharge Sec.-Ft.	Average Cross-sectional Area Sq.Ft.	Wetted Perimeter Ft.	Hydraulic mean depth $= r$ Ft.	Slope $= s$	$\sqrt{rs}$	Mean Velocity $= v$ Ft. per Sec.	$\frac{v}{\sqrt{rs}} = c$	n
For Cleared Course of Floodway												
4/1/22	337.43	5.2	828.8	4,137	4,322.6	829.8	5.21	.0000843	.0210	0.957	45.6	.047
4/2/22	337.71	5.5	829.7	4,078	4,540.8	830.6	5.47	.0000696	.0195	0.898	46.1	.047
4/3/22	337.18	5.0	828.1	3,141	4,101.0	829.1	4.95	.0000540	.0163	0.766	47.0	.044
4/4/22	336.55	4.4	826.6	2,243	3,579.7	827.6	4.33	.0000506	.0148	0.627	42.4	.048
For Uncleared Course of Floodway												
4/1/22	336.77	4.5	824.9	2,672	3,698.0	825.8	4.48	.0001592	.0267	0.723	27.1	.077
4/2/22	337.14	4.9	826.7	2,631	4,004.2	827.2	4.84	.0001233	.0244	0.657	26.9	.079
4/3/22	336.75	4.5	825.4	1,875	3,682.0	825.9	4.46	.0000798	.0188	0.509	27.1	.077

Gagings of the flow in the floodway were made at stations midway between the ends of the two courses. Velocity measurements were made with a Gurley-Price current meter from a boat. The boat was attached to a ¼-in. wire stretched across at a right angle to the floodway and held in place by poles as shown in the illustrations. The wire was secured at both ends and could be adjusted to the desired height on the poles, depending upon the depth of the water in the floodway. An anchor was used at the stern of the boat to hold the boat steady and parallel with the direction of the current. Measurements of the velocity were made at top, middle and bottom depths, and at intervals of 40 ft. across the floodway. Measurements in the main channel were made at intervals of 10 ft.

The slope of the water surface was measured on both sides of the floodway and the utmost care was exercised in order to secure accurate measurements. Cross-sectional measurements of the floodway were made at intervals of 500 ft. The mean of the slopes of the water surface as measured on each side of the floodway, and the average of the cross-sectional areas, were used in the computations.

The investigations were made by the writer under the direction of S. H. McCrory, chief, Division of Agricultural Engineering. H. J. Bartz, junior drainage engineer, assisted with the computations and field examinations. Engineers of the Little River Drainage District furnished valuable advice and assistance.

Lost Time in Construction—2

Winter Idleness

Methods of Doing Work in Cold Weather Are Well Developed—Economics of Year-Around Construction is the Unsolved Problem—Extensive Research Required

By **C. S. Hill**
Associate Editor, Engineering News-Record

Second of a Series of Four Articles

CONSTRUCTION generally is curtailed in winter. During this comparatively idle period the industry is sustained by drawing on what it earned in the portion of the year when it was active. The correction of this condition is a task which engineers and contractors are called upon to undertake as their share in solving the great problem of reducing industrial waste.

Winter construction presents a technical and an economic problem. The technical problem is to develop effective construction practices for cold weather; it has to a considerable extent been solved. The greater problem is economic and almost no purposeful effort has been made to solve it. It involves the stupendous labor of changing construction, with its correlated activities, from a seasonal to a year-around industry and the simultaneous changing of building habits.

Obviously, reformation of the country's second largest industry cannot be accomplished out of hand. It is possible, however, to state the problem, to disclose the means that have been employed to solve it and possibly to suggest further means. A comparatively superficial examination indicates amazing possibilities of immediate progress, particularly in codifying and correlating methods of cold weather construction.

Governing Conditions—Cold affects adversely every element of construction; labor, water supply, drainage, materials, equipment, transportation and structure suffer disturbance. Extreme frost aggravates the effect of cold, and wind and snow magnify the action of frost. From these two facts come the first two general conditions of winter construction.

1. Winter construction is a different problem in different temperature zones—for example, the Canadian line states, the Gulf and Mexican boundary states and the belt of states between have separate problems in winter construction.

2. In any locality the possible volume and continuity of winter construction change as the season is mild or severe, is open or has a heavy snowfall, is of even or fluctuating temperature and has few or frequent storms.

Certain construction processes are obviously more susceptible to disturbance by cold weather than are others. Shallow excavation and fill over wide areas, steel erection high in the air and concrete road construction are particularly exposed to the effects of frost and storms. Tunneling or deep excavation in cuts or pits of small area and interior building construction are comparatively sheltered. From these facts comes a third generalization:

3. The nature of the construction operation largely determines the practicability of its successful prosecution in winter.

On the face of the three conclusions which have been stated, the problem of winter construction appears to have many complexities. This is true if the economic solution is being sought. While the technical solution differs with temperature and weather conditions, the difference lies in the degree to which cold weather construction methods are required and not in the methods which have to be employed. Once the processes are determined for, say, excavation or concrete construction, the only change in practice required in any circumstances of temperature and weather is the extent to which all or any of the processes have to be employed. A fourth general condition results:

4. Weather and temperature conditions determine the extent to which cold weather construction methods may be necessary but do not necessitate any change in the nature of the methods.

Statement of Problem—With these fundamental conditions established the problem of winter construction is to determine (1) the kinds of construction which can be performed in winter; (2) the methods of and equipment for cold weather work; (3) the extra cost of doing winter work and (4) the expenditure warranted to secure the increased production resulting from winter operations. A fair start has been made in determining the kinds of work that can be done and the methods of doing it. In some kinds of construction, particularly concrete building work, the excess cost of winter construction has been fairly well established; but experience furnishes no facts of importance on the economics of winter construction as a general practice.

The progress that has been made in winter construction is the best promise of its future possibilities. To make the statement specific, consideration is limited to heavy excavation, road building, municipal works and concrete and building construction. As a matter of fact, however, other operations introduce few conditions which require different methods, so that the determinations reached for the operations named comprehend construction in general.

Heavy Excavation—The following conclusions have been set down from notes on about twenty steam shovel or dragline heavy excavation operations described in technical journals or personally observed:

1. With preparations and precautions which can be carried out without serious difficulty heavy excavation can be confidently undertaken in winter.

2. Generally depth of cut and volume of material in a restricted area determine the feasibility of winter operations. Shallow cuts not penetrating the frost crust are not practicable except as emergency operations.

3. Labor is somewhat less efficient in cold

weather. Men have to be relieved from work at intervals to warm themselves, particularly those working in exposed positions like that of cranesman on a steam shovel. Warm clothing is necessary—not merely anything that will keep out the cold but clothing designed to allow bodily activity like, for example, the outfit for Red Cross workers in Russia. In the most severe frost, shorter working days are necessary. On the other hand, owing to general winter idleness, more choice is possible in the men employed.

4. Motorized hauling equipment—motor trucks, tractors and locomotives—and in general machinery for all operations should be used to the utmost extent because it reduces the number of men and teams to be affected by cold and has excess power to meet the more difficult operating conditions caused by frost.

5. Water supply, except when urban supply is available, is expensive. Surface pools and pipe lines will not do. Frost-protected pumps, pipes and tanks or tank-car haulage are required.

6. Excavating equipment has to be prepared for winter work by insulating steam pipes and cylinders and closely housing every working part which it is practicable to shelter.

7. Snow sheds and barriers help to keep pits and cuts free from drifted snow and can often be installed at small expense.

8. Efficiency is gained by blasting the frozen crust, particularly in dragline work, and it is generally advantageous to "dig in" before frost so as to have a good working face when frost comes. In winter blasting the use of non-freezing explosives or of means to keep explosives unfrozen are essential.

9. If the cold is particularly severe and continuous, double-shift operations, so as to keep ahead of the frost, may, in large operations, be profitable.

10. Power-dump cars are superior for handling spoil, usually mixed with snow and liable to freeze so that it is hard to dump. Prompt movement of spoil trains is necessary for the same reason.

11. More capable supervision is required to meet the hazards of frost and storm.

12. Electric-motor or gasoline-engine-driven equipment greatly reduces the difficulty of water and fuel supply.

Road Building—Second to industrial and residence building-construction, road building is the most general construction operation and involves the largest expenditures. As a winter construction problem it, therefore, has great economic importance. It also introduces conditions of earth moving, hauling, water supply and fabrication of structure (paving or surfacing) which are not common in general excavation and in concrete and building construction.

Earth moving in road construction generally involves shallow cuts and fills. Where heavy cuts and fills have to be made the conditions are those of heavy excavation just previously considered. Cuts and fills not deeper than the frost crust are practically impossible once the crust has frozen. It has been found practicable, where the grading has been completed, to prevent freezing for a time while pavement was being constructed. The method was to stretch three lines of steam pipe from a steam roller along the subgrade and to cover them with straw and a canvas blanket. In general the following conclusion is warranted:

1. Except as an emergency operation and except in cuts and fills of considerable magnitude winter grading of highway is impracticable.

While grading is, broadly speaking, not a winter possibility, the next most important operation of hauling is made easier in some respects by cold weather. Frost hardens the ground. Snow gives a track for sleds. If storms are not too frequent winter hauling is entirely practicable in road building (1) to stockpile construction materials and (2) to distribute gravel surfacing. In Wisconsin and Minnesota many miles of gravel surfacing have been successfully and economically placed in winter. Stated as a conclusion:

2. In road building the hauling of construction materials and equipment is entirely practicable in winter with probably no more delay because of wind and snow storms than is experienced in summer because of rainfall.

Water supply in winter road work is even more serious a problem than it is in heavy excavation; conclusion (3) under heavy excavation applies to water supply for road building, and is here repeated:

3. Water supply, except where urban supply is available, is expensive. Surface pools and pipe lines will not do. Frost-protected pumps, pipes and tanks or tank-car haulage are required.

There are numerous examples of winter paving operations which have demonstrated that any kind of pavement may be constructed by (1) heating the materials; (2) housing and heating the subgrade and the completed pavement; (3) using chemicals to retard freezing. These are all common processes in concrete building construction and are described in many articles and books.

There are virtually no records of the extra cost of winter road building. It has been variously assumed as 25 to 50 per cent more than the cost of summer construction, but these figures are nothing but guesses.

Winter road building is not practicable as a general proposition in states having a severe winter climate; it is practicable to prolong the construction season well into the fall season of moderate night frosts by methods which do not call for elaborate equipment or excessive expenditure; it is also practicable to do in winter a large amount of hauling and storing materials and other work preparatory to warm weather construction.

Municipal Works—The only recorded study of winter construction practices has been made by Canadian engineers. In 1920, inquiry made by Prof. W. Clifford Clark, Queens College, Kingston, Ont., of 36 Canadian cities which had done municipal work in winter, disclosed the following information:

The kinds of work pronounced successful, or fairly so, are sewer construction, tunneling, deep excavation, heavy cuts and fills, mass concrete and work in muskeg or swamp where subsurface water prevails. The degree of success depends upon the preparation which is made in the fall for continuing work in severe weather and also on the supervision of the work.

Estimates of the increase in the cost of construction in winter vary from nothing to double the cost of summer work. In some instances winter construction was found less expensive. In all cases the kind of work

and the local weather conditions must be taken into account.

There is general agreement that tunneling can be done as economically in winter as at any time. The average increase in the cost of rock excavation is less than 25 per cent. In ordinary sewer work the increase probably runs from 25 to 100 per cent.

Various reasons are given for the increased cost. The frozen top has to be broken through. Spoil banks freeze. Brick and concrete materials must be heated. Workmen have to be sheltered and provided with means of warming themselves.

In general winter work keeps organizations intact, overhead charges are spread over twelve months and wages are lower.

Concrete and Building Construction—Work on concrete structures of all kinds, and building operations generally, are commonly carried on in winter. Methods have been highly perfected and are now text-book knowledge. The conditions can be stated as follows:

1. All concreting and building masonry operations can be carried on in winter with dispatch and absolute safety by heating the materials, housing in the work under construction and heating the enclosure.
2. Steel erection in winter is largely a function of storm and temperature. In any weather in which the workman can withstand the cold and work safely, structural steel can be erected.
3. Interior building work, plumbing, steamfitting, plastering, etc., can be performed in winter with little loss of efficiency.
4. Winter construction in building adds from 3 to 10 per cent to the cost according to the records of large concrete building contractors.
5. There is probably some greater risk of poor workmanship in winter concreting, masonry work and steel erection which calls for more exacting supervision and inspection.

General Conclusions—Nothing in the general conditions laid down, or in the conclusions from practice, place the problem of methods of winter construction beyond the range of easy solution by engineers and contractors. With very moderate inquiry and analysis it would be practicable to state recommended practices or standard methods. This investigation may precede more complex study of economic conditions because whether or not winter construction in general is economical there are always individual operations which it will pay to carry on in winter. In other cases, such as winter hauling in road building, it may be profitable to perform parts of the work in winter. As a broad generalization of the technical problem of winter construction it may be concluded:

Any kind of construction can be performed for which the owner is willing to pay cold weather prices.

Economic Problems—The economics of winter construction do not lend themselves to the simple methods of handling the technical problem. As applied to a single structure the economic question is: Will possession of the structure at a definite earlier date be of enough value to pay for the extra cost of winter construction and leave a little over? Visualizing the construction industry as a whole the query is much the same. While, however, in the case of the individual structure the means are at hand for a ready answer there are inadequate, indeed almost no, data by which to determine the answer for the whole industry. Determination of these data is the great task of research before engineers and contractors and the *determination needs to be quantitative.*

Briefly, winter construction appears to offer economies by (1) spreading overhead costs over twelve producing months instead of some less period; (2) reducing the seasonal employment of men in construction and the allied industries; (3) ironing out the peak in the curve of production of construction materials and equipment; (4) equalizing the demand on transportation agencies. The economic waste in all these activities due to reduction of construction during cold weather is universally admitted as a general truth but there are no determined figures of the amount of waste. These quantitative data are what research is called upon to supply. The reasons are:

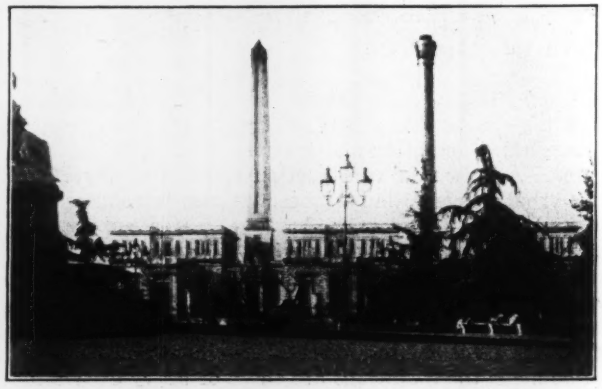
1. The construction industry is the servant of the building public and evidence of specific savings is necessary to induce the building public to alter its practices.
2. Without full knowledge of the economic waste from winter idleness in construction the industry cannot stabilize its own business or assume the duty, which it must, of teaching the building public.

The third article of this series—developing the problem of Rain and Mud Delays in detail—will appear in the next issue.

Water Treatment Works of Buenos Aires, Argentine Republic

Coagulation and Sedimentation Before Slow Sand Filtration Form One of the Features

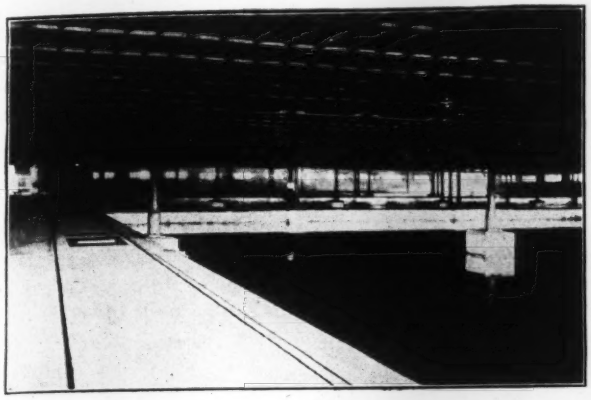
COAGULATION and sedimentation before slow sand filtration is a feature of the water supply of Buenos Aires, Argentina. The city, which has a population of about 1,500,000, draws its water supply from the Rio



PUMPING STATION AS SEEN FROM ALVEAR AVENUE

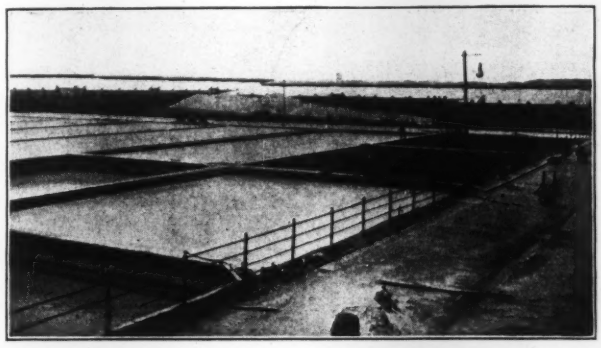
de la Plate, pumps it to coagulation and sedimentation basins, passes it through slow sand filters to clear-water reservoirs and then pumps it to a distributing reservoir.

Because of the finely divided matter in suspension and the humus matter in solution the water is not only settled before filtration but is also coagulated by means of sulphate of alumina, introduced just before the water is discharged from the force mains to a distributing



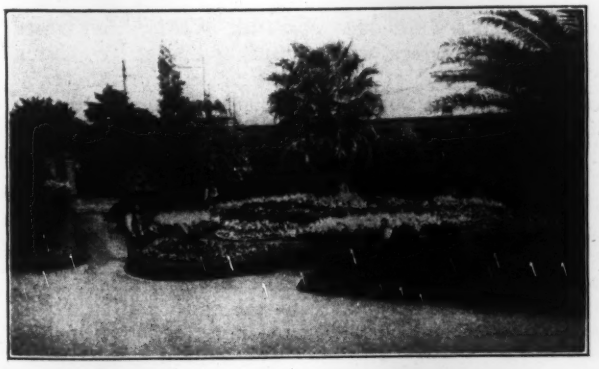
INTERIOR OF FILTER HOUSE

chamber which supplies the settling reservoirs. No detailed information is available regarding the design of this chamber, the settling reservoirs and the filters, except that the beds are composed of graded layers of sand resting on similar layers of gravel; that the filter underdrains discharge into filter regulators; and that



SETTLING RESERVOIRS AND FILTER HOUSE

there are ten filters, with a combined area of 54,069 sq.m. (581,782 sq.ft., or about 13.3 acres). As to purification results, Mr. Negri states only that coagulation and sedimentation reduce the bacteria 80 to 90 per



GARDENS WITH FILTER HOUSE BEHIND

cent and that the filters add to the clarification of the water and "destroy the organic matter which has not been precipitated before filtration."

The clear-water reservoirs are located under 5 of the 10 filters and have a total capacity of 91,248 cu.m. (24,000,000 gal.).

The high-service pumps are of various types, including two triple expansion pumping engines and some electric-driven centrifugal pumps. They have a combined daily capacity of 310,200 cu.m. (about 81.5 m.g.d.) and deliver filtered water to a large distributing reservoir through seven inter-connected and valve-controlled 51 to 91.4 cm. (20- to 36-in.) cast-iron force mains.

The accompanying views of the pumping and purification plants have been sent to *Engineering News-Record* by Henry W. Wendt, president, Buffalo Forge Co., who visited Buenos Aires some months ago and made the acquaintance of Mario L. Negri, civil engineer of the waterworks. In February of this year Mr. Negri supplied Mr. Wendt with photographs and descriptive notes of the water-works, from which the material here presented has been selected.

Intake towers and tunnels lead the water to low-service pumps, of a combined capacity of 367,000 cu.m. per 24 hours (97 m.g.d.) which have a lift of about 10 m. (33 feet).

Layer of Fine Sand Within Slow Sand Filters at Chester, England

A LAYER of fine sand beginning 15 in. from the top of the water-works filters of Chester, England, has stood the test of time, stated F. Storr and C. W. Bennett in a recent paper before the British Institution of Water Engineers, and doubtless "the remarkable results obtained are in great measure due to its action." The composition of the entire bed and further excerpts from the paper just mentioned are given in the London *Surveyor* of June 16, 1922, as follows:

As is well known, it is a comparatively simple matter to reduce by filtration the total bacteria contained in a raw water from thousands per cubic centimeter to hundreds, or perhaps tens, but reduction below some such limit can seldom be continuously relied upon by the ordinary practice, and it is in effecting this object that the interposed layer of finer sand serves a useful and important function. It is true that sub-surface clogging takes place to a slight extent

ARRANGEMENT OF MATERIAL IN CHESTER FILTERS

	Ft.	In.
Perforated bricks on filter bottom	0	4½
Pebbles passing ¾-in. mesh	0	4
Fine pebbles passing ½-in. mesh	0	2
Coarse pit sand 60 per cent retained on a 40 per inch mesh	1	3
Fine pit sand 65 per cent retained on a 70 per inch mesh	1	0
Coarse pit sand 60 per cent retained on 40 per inch mesh	1	3
Total depth	4	4½

in course of time, but this is remedied by going down to the fine sand-layer and removing a light scraping from its upper surface when replenishing the coarse sand removed by successive cleanings.

There are practical reasons why the fine sand should not be placed on the top, as the trampling it would receive in the course of cleanings would quickly reduce it to an impervious mass, and when removed to the sand-washers, together with algae, mud, and other debris, it would not be so readily dealt with as with the coarser grade of sand.

The rate of filtration varies from 0.75 to 2 [Imp.] gal. per sq.ft. per hour [0.9 to 2.4 U. S. gal. per hr. or 940,000 to 2,500,000 U. S. gal. per acre per day.—EDITOR.]

Aerial Tramways Serve Mixing Plant at Gilboa Dam

Rugged Country Makes Surface Roads Difficult—Air Lines Reliable and Cost Less—Lines Have Surplus Capacity—Operation Undisturbed by Rain and Snow

By Charles K. Traber
A. Leschen & Sons Rope Co., St. Louis, Mo.

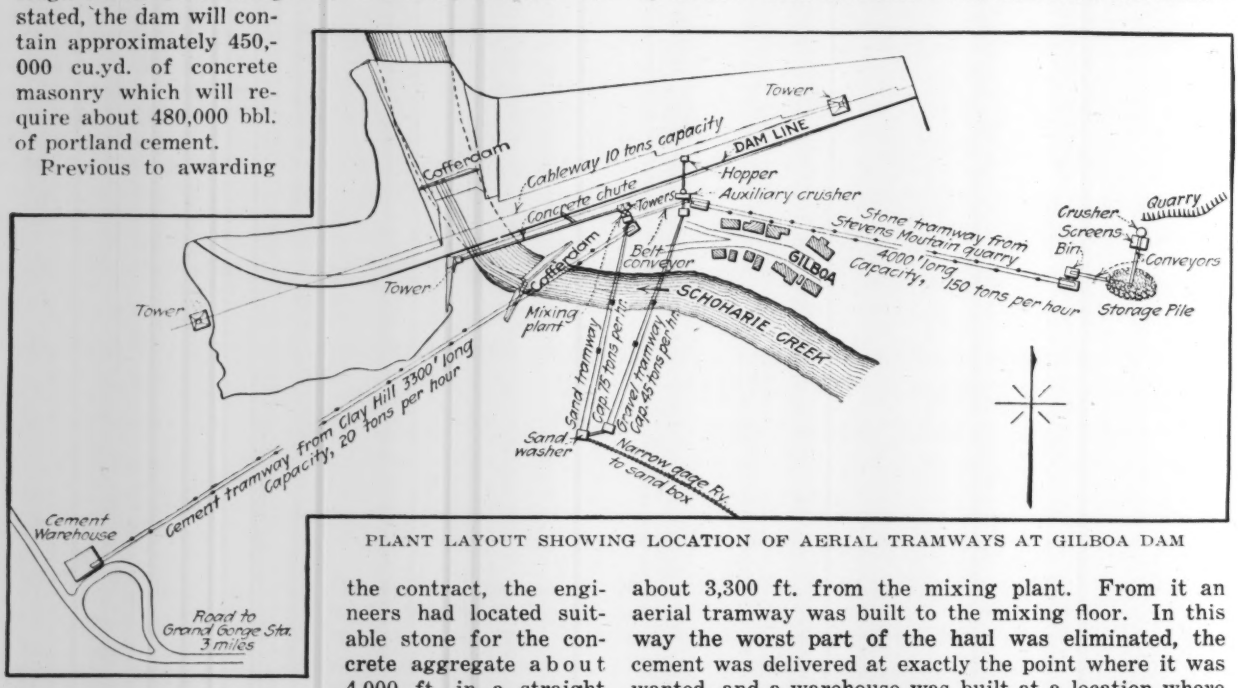
AERIAL tramways are transporting all the concrete materials for the 450,000 cu.yd. of concrete in the Gilboa Dam for the water-supply system of New York City. It is believed that this installation is one of the most extensive ever employed on a construction operation and its success in meeting, at a comparatively reasonable cost, the requirement of providing, in a rugged country, a large and uninterrupted supply of materials makes it especially interesting to the construction engineer and contractor.

The Gilboa Dam a part of the latest link in the New York City Catskill water supply, is located at the town of Gilboa, N. Y., about four miles by road from the Grand Gorge Station of the Ulster & Delaware R.R. The contract for building the dam was awarded to the Hugh Nawn Contracting Co., of Boston, in 1919. As stated, the dam will contain approximately 450,000 cu.yd. of concrete masonry which will require about 480,000 bbl. of portland cement.

Previous to awarding the contract, the engineers had located suitable stone for the concrete aggregate about 4,000 ft. in a straight line from the proposed location of the mixing plant, but at a somewhat higher elevation. Suitable sand was located on the banks of Schoharie Creek, about three miles upstream from the site of the dam. The cement had to be brought in from the railroad, the nearest station of which was about four miles from the site of the dam. The road was a poor one, having some very heavy grades and being difficult to keep in condition.

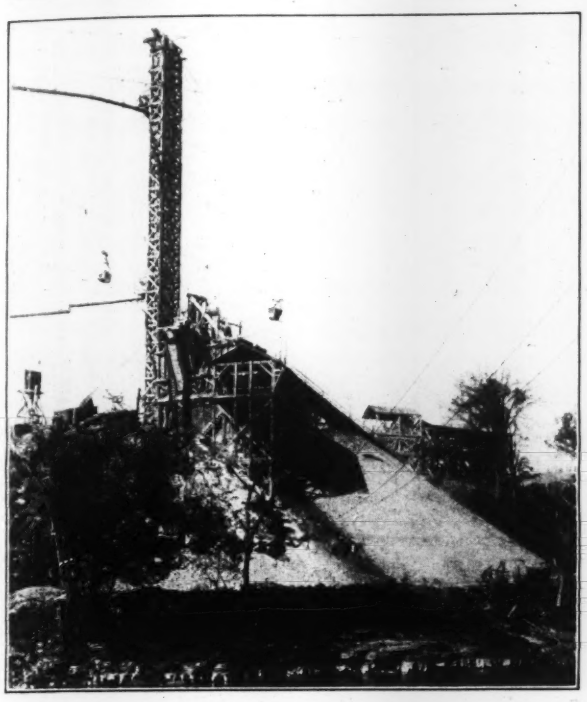
To find some means of getting these 480,000 bbl. of cement from the railroad to the mixing plant was the contractor's first problem. An aerial tramway connecting a switch, at a suitable location on the railroad, directly with the mixing plant was the first thought. This tramway would have been somewhat over three miles in length. However, it was found that a right-of-way could not be secured, except at an unreasonable cost, and it was necessary to abandon this idea. Still, hauling by road was a worse solution. The logical place for the mixing plant was on the far side of the gorge, across which the dam would be built, and the road crossed this gorge at exactly the location of the dam. If the cement, then, were to be brought in by road, it would have to go over a new road to be built to take the place of the old road which made the distance over a mile longer.

Finally it was considered that an aerial tramway might be built across the gorge and over the worst part of the ground to a favorable location on the old road for a warehouse, to which the cement could be brought by trucks. This was done. The warehouse was located about 3,300 ft. from the mixing plant. From it an aerial tramway was built to the mixing floor. In this way the worst part of the haul was eliminated, the cement was delivered at exactly the point where it was wanted, and a warehouse was built at a location where it did not interfere with the other operations taking place at the point of work. The capacity of this tramway was fixed at 20 tons of cement per hour, although it can easily be pushed to a greater capacity if this becomes necessary.



PLANT LAYOUT SHOWING LOCATION OF AERIAL TRAMWAYS AT GILBOA DAM

The next problem was to handle the crushed stone from the quarry, which was located on the side of a mountain about 4,000 ft. distant from the mixing plant and on the other side from the cement tramway. A narrow-gage railway would have meant a considerable amount of grading, and it did not figure out nearly so well as an aerial tramway, so this method of transport was again chosen. The capacity required here was 150 tons of crushed stone per hour. The stone, after being



MIXING PLANT AND TOWER FOR GRAVITY CHUTING
In the left foreground is seen a carrier on the cement tramway approaching the terminal; in the center a carrier of the sand tramway, and in the background the terminal of the stone tramway.

crushed and screened, is deposited on a storage pile, under which is a tunnel in which runs a belt conveyor. This belt conveyor delivers the stone into a small bin from which the tramway buckets are fed. At the mixer end it was found convenient, instead of making the mixer bins the terminus of the tramway, to build this terminal next to an auxiliary crushing plant which handled the rock taken out of the excavation. The tramway buckets, therefore, deliver their loads to the belt conveyor which handles the material from the auxiliary crushing plant up into the mixer bins.

These two problems having been disposed of there remained the problem of transporting the sand from the bank to the mixing plant. A narrow-gage railway proved to be the best method of handling the sand from the sand bank to a washing plant which was located just across Schoharie Creek from the mixing plant. A short aerial tramway from this washing plant to the bins over the mixers was decided upon. The capacity required here was 75 tons per hour.

After sand washing plant had been in operation for several months, it was found that a great quantity of small boulders and gravel accumulated, which were wasted at the site of the washer. It seemed a pity to waste this material, since it had to be handled for the three miles from the sand bank to the washing plant and run through this plant, so it was decided to utilize the auxiliary crushing plant and to carry this gravel and boulders by means of a fourth aerial tramway from the washing plant to the auxiliary crushing plant. This tramway, being suitably located, could also be used as an auxiliary tramway for handling sand. This is accomplished by running the surplus sand from the washing plant onto a large storage pile, which also helps in de-watering, and then handling it from there by means of a derrick and clamshell into a small bin which feeds the aerial tramway buckets.

Although aerial tramways have been previously used very successfully in construction work, this is the first place, to the writer's knowledge, where all the principal materials going into the work are being so handled. The advantage in this particular case has been very clearly demonstrated. These tramways have been in operation since October, 1921, and during the month of May, 1922, as much as a thousand yards of concrete per day were placed on some days. There was no interruption of work at any time due to failure to deliver the material; in fact, at nearly all times, the tramways ran ahead of the mixer and had to be run intermittently in order not to overflow the mixer bins.

The advantages of tramway transportation can be briefly stated as follows:

1. The lines can be built over very rough ground, usually as easily as over level country.

2. Operation is not interfered with by weather conditions, since all of the essential parts are up in the air and out of the way.

3. The cost of upkeep is quite small, since all of the parts subject to wear can be taken care of very easily; and the speed being slow, there is no danger of derailments.

As indicated on the layout plan the cement and stone tramways are of the continuous type and operate much like a belt conveyor, inasmuch as they carry comparatively small loads at frequent intervals and travel at a slow speed. It is the continual flow of material that allows large capacities to be secured with a comparatively inexpensive equipment. The sand and gravel tramways are of the two-bucket type and consist of only two carriers running back and forth each on its own rope. Large capacities can be secured here because the distance to be covered is small. In other words,

LOADING TRAMWAY BUCKETS WITH CRUSHED STONE
Stone is chuted into bucket from overhead bin; a 1-cu.yd. bucket is loaded in about four seconds.

the type of aerial tramway is adapted to the conditions to be met.

The cost of operation is quite small. The load being uniform and the friction moderate, but little power is required. In fact, both the stone tramway and the cement tramway operate by gravity when running at full capacity, although the drop is slight between the loading and discharge points.

When the material can be handled through chutes from a bin, as in the case of the crushed stone tramway, very little labor is required. In this particular case, three men can handle the loading terminal very nicely; and, in fact, if it were not for the necessity of often starting and stopping the tramway on account of the bins becoming full, two men could probably handle this terminal. At the discharge end two men also handle the buckets. Under certain conditions the discharging end of these tramways can be made automatic, if it is found more economical to put in a little more equipment and save on labor. For smaller capacities, both the loading and discharge can be made automatic. The two-bucket tramways require but one man each for the entire operation.

If the reader will imagine what would have been required on this job with the usual methods of transportation, where in the first case a very deep gorge, with a span of some 500 ft. had to be crossed, in the second case hills and valleys of various heights and depths, and in the third a swift stream, which would occasionally rise very rapidly, he can easily see the advantages of the air-line system.

An alternative in the first case would probably have meant a long detour with trucks, and then the cement

LOADING BAGS OF CEMENT INTO TRAMWAY BUCKETS

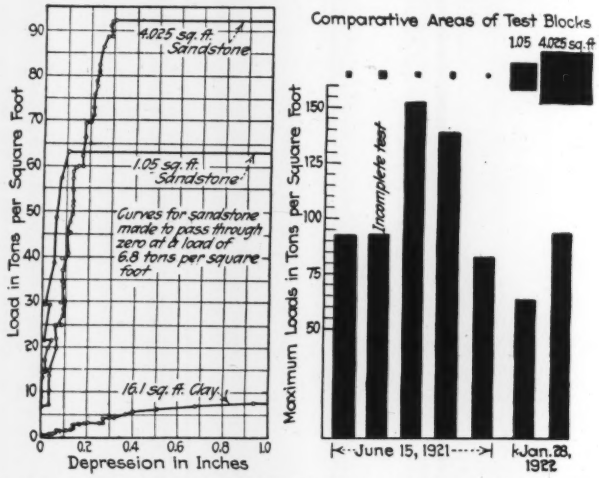
would only have been delivered on the ground at the foot of the mixing plant. In the second case, that of the crushed stone tramway, a narrow-gage railroad would probably have been the next best solution, and this would have had many curves in order to keep down the grade, and again the stone would probably have had to be delivered at on inconvenient point. In the third case, that of the sand tramway, it would have been necessary to build a bridge across the stream, with a belt conveyor and then a bucket elevator at the mixing plant, to elevate the sand into the mixing bins.

The line drawings and views give a general idea of the construction of these aerial tramways, all of which were designed and furnished by the A. Leschen & Sons Rope Co., of St. Louis, Mo.

Foundation Tests for Nebraska State Capitol

Methods and Results of Loading Small and Large Test Areas of Sandstone and Loess Clay—Breaking Load Disintegrates Rock

BEARING tests on clay and rock in which test areas of 1 to 16 sq.ft. were loaded and the disintegration pressure for sandstone was determined have been made


Load in Tons per Square Foot
4.025 sq. ft. Sandstone
1.05 sq. ft. Sandstone
Curves for sandstone made to pass through zero at a load of 6.8 tons per square foot
16.1 sq. ft. Clay
Depression in Inches
Comparative Areas of Test Blocks
1.05 4.025 sq. ft
Maximum Loads in Tons per Square Foot
Incomplete test
June 15, 1921
Jan. 28, 1922

FIGS. 1 AND 2. LOADING TESTS ON CLAY AND SANDSTONE

on the site of the new State Capitol at Lincoln, Neb., with the result that all foundations will be on rock and that a limit of 15 tons per square foot was recommended. The architect is using a 12-ton unit load in his designs.

This building is to be a hollow square with 437-ft. sides and having the interior space divided by a cross-shaped structure at the center of which will be a tower 80 ft. square and 405 ft. high above the ground. The outer portion will have only two stories, attic and basement, but the inner portion will be somewhat higher. This combination of low structure, interior courts and

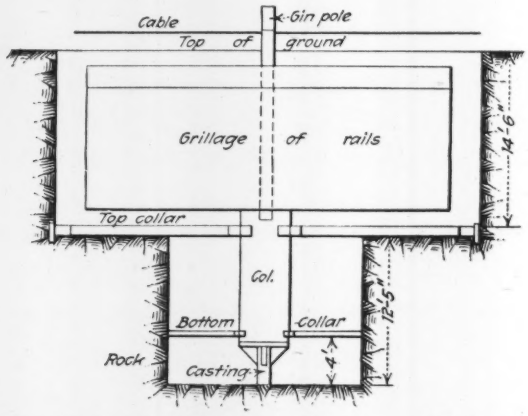


FIG. 3. LOADING APPARATUS FOR FOUNDATION TESTS

long exterior walls is designed to provide abundant light for every room without the aid of skylights and light shafts.

Soil Conditions—Under a black top soil 1½ to 5½ ft.

thick is a 15-ft. bed of loess clay, and then approximately 6½ ft. of gravel (glacial drift with boulders) over the Dakota sandstone. The clay will stand in excavations without need of sheeting. The bed rock is a light buff sandstone, but at some points there is an upper 7½-ft. bed of light brown sandstone which is

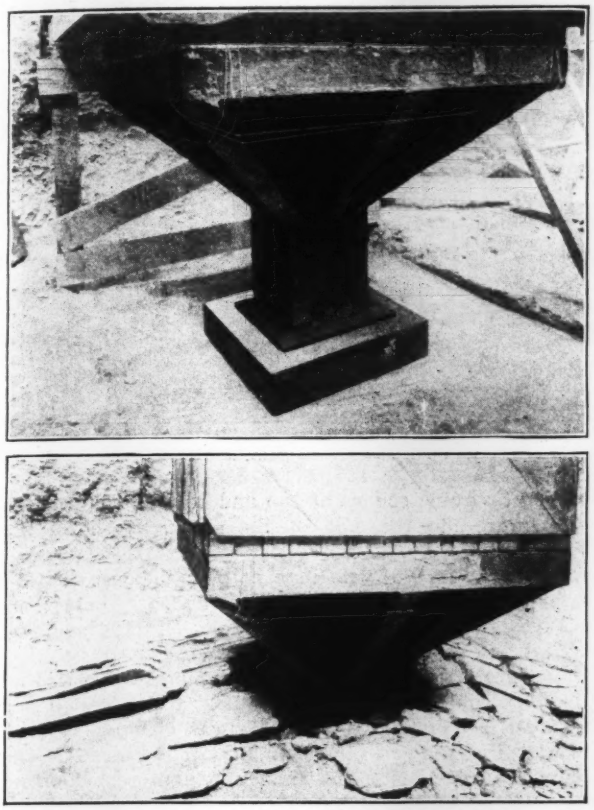


FIG. 4. RESULT OF LOADING TEST ON FOUR SQUARE FEET OF ROCK

separated from the bed rock by a seam of soft blue shale. The Dakota sandstone bed rock is too hard for excavation by picks or grab buckets without the use of explosives, but pier excavations or shafts can be enlarged or belled at the base by picks in order to provide the necessary bearing area. It is an almost pure silica sand weakly cemented with iron oxide. The stone is easily scraped or bored and after being removed from its bed many of the particles can be crushed readily in the hand.

Fig. 1 shows the loads and deflections in the tests in clay and rock, and Fig. 2 gives the comparative test areas and loads in the rock tests.

Tests on Clay—In preliminary tests on the loess clay 8 ft. below the surface 2 x 2-in. and 3 x 3-in. blocks were forced down continuously while the load was increased to 421 and 369 lb. per square inch respectively. Later an area of 16 sq.ft. at a depth of 17 ft. was loaded by the plunger shown in Fig. 7. The result is plotted in the left-hand curve of Fig. 1. Settlement was appreciable at 3.24 tons per square foot; the maximum load reached was 7.9 tons per square foot, with 1.30 in. settlement.

Tests on Soft Rock—For a test of the upper stratum of rock (light brown sandstone) a 7¼-in. loading post (52.6 sq.in.) was placed on a cleaned surface at 17 ft. depth. A small but gradual penetration continued up to a load of 112 lb. per square inch, and was followed by a more rapid penetration, reaching 1.3 in. at 218 lb. In a second test, a 4 x 4-in. block under the post settled gradually with increasing load, until at a unit pressure of 486 lb. it was flush with the surface of the rock.

Tests on Bed Rock—In a test on bed rock at 39.6 ft. below the surface, with a 2 x 2-in. loading block, the sandstone gave way suddenly at a unit pressure of 1,160 lb., apparently flowing from under the block and carrying the edges of the block with it. A block 3 x 3 in. in another position was loaded to 1.275 lb. per square inch without failure and with a settlement of only 0.005 in., but this 5½-ton load was the maximum that could be applied safely. With a 2 x 2-in. block in a water-filled hole the rock in one test failed at 1,973 lb. unit pressure, while in another test the block split at 1,965 lb. A steel block 1⅝ in. in diameter gave sudden failure of the rock at 1,210 lb., the rock penetrating about an inch.

Two tests on large bearing areas were made. In one a casting bearing on the rock with a face of 1.05 sq.ft. (Fig. 3) carried the 4 x 4-ft. loading column already mentioned; the results indicated that the sandstone was elastic up to a load of approximately 50 tons per square foot. Failure occurred suddenly at 63 tons, with all the testing apparatus dropping 6.3 in. due to the bearing surface penetrating the sandstone. Up to this loading the total settlement had been 0.11 in. In the second test the loading casting was placed upon a cast-iron block having a bearing area of 4 sq.ft. (Fig. 4). Two microscopes, placed as in Fig. 5, were used in this test to supplement the level readings on a vertical steel rod. The microscopes were removed when the load reached 52 tons per square foot, in view of the 63-ton limit of the previous test, but failure did not occur until the load reached 94.4 tons, when the rock failed suddenly. The loading began on Dec. 14 and failure occurred on Dec. 23. The maximum depression under load was about 0.30 in. until the failure, when the block penetrated the rock to a depth of over 13 in. below the depression, as shown in Fig. 4. These two tests are plotted in Fig. 1.

Conclusions as to Bearing Strength—After the first series of tests, in May, 1921, it was concluded that the loess clay has as great a bearing strength as the upper stratum of sandstone and that the safe load was 3 tons

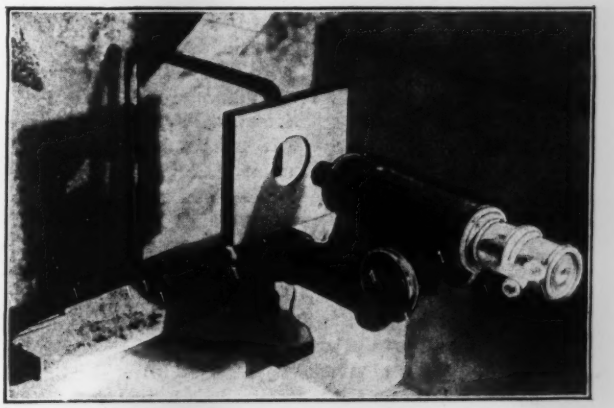


FIG. 5. MICROSCOPE SET FOR OBSERVING DEFLECTIONS

per square foot for depths not exceeding 25 ft. For the sandstone bed rock at depths of 30 to 40 ft. the safe load was estimated at 15 tons. From the results of the second set of tests, in December, the safe load of the clay was estimated at 2 tons per square foot and that of the bed rock at 15 tons. The architect is using

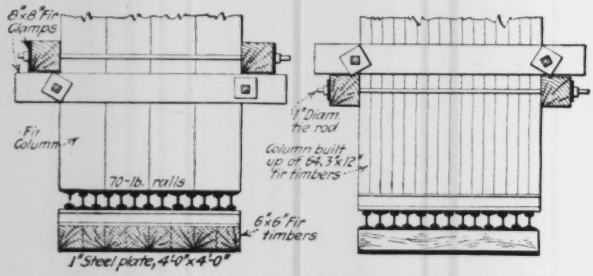


FIG. 6. METHOD OF LOADING 16 SQ.FT. OF CLAY

a 12-ton unit foundation load in the design of the structure.

These tests also indicated clearly that the entire building should be founded on the sandstone, since no arrangement of foundation could be designed to carry the building loads on both clay and rock without resulting in unequal settlement. Further, the foundation engineer's estimate of a combined foundation on both the clay and sandstone exceeded his estimate for an all-rock foundation at 25 to 45 ft. depth.

Testing Apparatus—In the May tests a 12-ft. post 7¼ in. square had a loading platform near the bottom, as shown in Fig. 7, and was held plumb by having its upper end fitted to a square collar on a lever of adjustable length wedged across the pit. Two plumb-bobs were hung on the post and a vertical scale was attached to a nail in it. For observations, a thread was stretched between nails at the sides of the pit, being kept tight by having one end tied to a rubber band fastened to the nail. In testing, the post rested on a bearing block.

Placing the load of 90- to 180-lb. tractor rollers by hand gave the platform a tendency to rotate and this tendency being transmitted to the testing block caused a grinding action which probably was responsible in part for the deflection. Slight impact in placing the weights was also unavoidable, but these factors of twisting and impact were not large. For testing, the platform was loaded as evenly as possible. Ditches were provided for excluding storm water, and at night the pit was covered with a large tarpaulin.

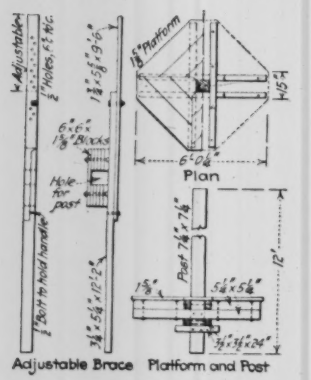


FIG. 7. APPARATUS FOR TESTS ON SMALL AREAS

For loading a test area of 16 sq.ft. in the December tests on the clay, the arrangement shown in Fig. 6 was used. Upon the upper layer of rails was seated an 11-ft. column 4 ft. square built up of 3 x 12-in. fir timbers, spiked, bolted and clamped together. For the later rock tests the column was stiffened by a covering of diagonal planks spiked to each side and then bound by heavy clamps and bolts. This column was held in

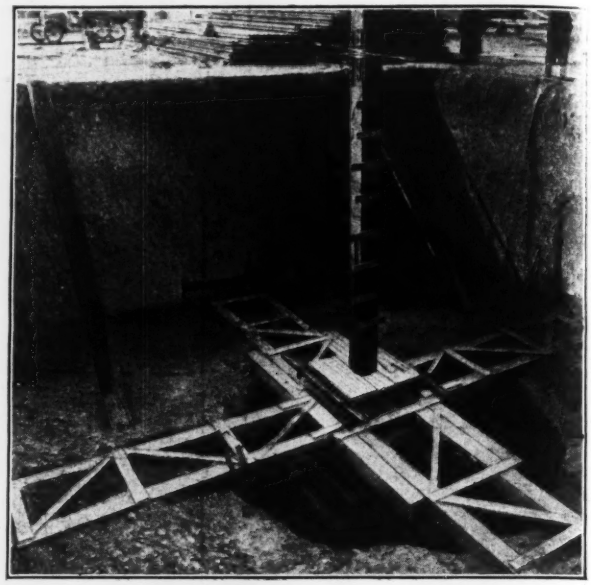


FIG. 8. TEST COLUMN IN SHAFT READY FOR LOADING

position by guide collars at top and bottom, the collars being braced to the side of the shaft, as shown in Fig. 8.

A 12 x 12-in. gin pole in a hole 12 in. deep in the center of the top of the column was guyed by cables to four posts (see Fig. 3). This pole held the column vertical and served as a guide in placing the rails. In a 3-in. hole near the center of the column was placed a 1-in. pipe containing a ½-in. steel rod which rested on the steel bearing plate. A scale was clamped to the upper end of the rod for readings with a precise level.

For the rock tests, the timber column rested on a base casting with a top surface 4 x 4 ft. and a stem

FIG. 9. LOAD OF RAILS WIDENS TOWARD TOP

having a bearing area of 1 sq.ft., as shown in Figs. 3 and 4. In the first test this stem was set directly upon the rock, but in the second test it rested upon a cast-iron block which increased the bearing area to 4 sq.ft. For the load, layers of 56-lb. rails were placed upon the head of the 4 x 4-ft. column, the length increasing gradually from 4 ft. 1 in. at the bottom to 30 ft. at the top. Thus with a total load of 500 tons each rail would have been stressed to the allowable limit of 16,000 lb. per square inch. Fig. 8 shows the column in place in the shaft ready for the loading. Fig. 9 shows the load in place, with the arrangement of increasing length of rails as described above.

These tests were planned and carried out under the direction of Prof. Clark E. Mickey, consulting and testing engineer for the Nebraska State Capitol Commission. The May tests were made by W. B. Alexander, R. E. Glover and Wm. H. Pahl, of the State Department of Public Works. The November-December tests were made by the Jarrett-Chambers Co., Lincoln, consulting foundation engineers, assisted by Robert E. Glover, assistant testing engineer of the State Department of Public Works. Bertram G. Goodhue, New York, is architect for the Capitol.

Salaries of State Sanitary Engineers

By James A. Tobey
Washington, D. C.

EVERY state in the Union except Arizona, Delaware, Idaho, Nevada, North Dakota, Oregon, Utah, and Wyoming now has a state sanitary engineer. The District of Columbia also has such an engineer, though he is not under the Health Department, and there are engineering divisions in the Porto Rico and Hawaii Boards of Health. Next to the 40 bureaus of engineering in the state health departments come laboratory bureaus, of which there are 36; bureaus of venereal diseases, 35; child hygiene, 32; communicable diseases, 24; and other bureaus or divisions in lesser numbers.

The average yearly salary paid to 37 directors of engineering during 1921 was $3,220; for 24 heads of communicable diseases bureaus, $3,446; for 31 directors of child hygiene, $3,385; for 34 chiefs of laboratories, $3,356. Table I summarizes the salaries in the various divisions. (From the Report of the Committee on Salary Standards of the American Public Health Association, of which the author is secretary, dated August, 1922.)

TABLE I—SALARIES OF DIVISION CHIEFS, STATE DEPARTMENTS OF HEALTH

	$5,000 and up	$4,000-$5,000	$3,000-$4,000	$2,000-$3,000	Under $2,000	Total	Reporting Average
Child Hygiene	1	7	9	12	2	31	$3,385
Communicable Diseases	0	11	8	4	1	24	3,446
Engineering	3	9	11	12	2	37	3,220
Food and Drugs	1	1	8	6	1	17	2,900
Laboratory	1	10	15	7	1	34	3,356
Vital Statistics	1	1	5	6	5	18	2,412
Venereal Diseases	2	4	16	7	4	33	3,058
	9	43	72	54	16	194	

The highest salaries paid to bureau or division heads in any of the state health departments are one of $7,000 in Pennsylvania, which goes to the director of the division of engineering, and one of $7,000 in New York, paid to the director of laboratories. There are seven $5,000 salaries, of which two, in Ohio and Massachusetts, are received by engineers. The lowest salary paid to state sanitary engineers is $1,800, of which, however, there are only two, in Maine and New Hampshire. Nineteen engineers' salaries are below the average of $3,220, while 18 are above. A list of salaries of directors of engineering is given in Table II.

No salary less than $3,000 a year should be paid to any chief of a division of a state health department, according to the committee report mentioned above. Bearing in mind the factors of training, experience, length of service, personality and other qualifications of an individual, the committee believes that in most instances more than this sum should be paid. It will be observed that at present 14 state sanitary engineers receive less than $3,000 per annum.

The salaries of sanitarians have, as a rule, increased somewhat during the past few years. This does not hold true of state sanitary engineers, however. In 1920 there were 25 such engineers. Their average annual salary was $3,293, as compared to $3,220 now. On the other hand, the average compensation of state health officers increased from $4,040 in 1920 to $4,453 in 1922. There is no reason why the compensation of these engineers should not keep pace with that of other sanitarians. To be sure, a sanitary engineer requires two years less college training than does a medical man, but the character of his work is no whit less important than that done by any medical chief of a division. In fact, in many states, it is no exaggeration to say that most of the actual constructive public health work is done under the direction of the state sanitary engineer. More non-medical men with this type of training are needed in public health work and their remuneration should be made more attractive.

TABLE II—SALARIES, CHIEFS OF ENGINEERING DIVISIONS STATE DEPARTMENTS OF HEALTH

State	Salary	State	Salary	State	Salary
Alabama	$4,000	Maine	1,800	Ohio	5,000
Arizona		Maryland	3,250	Oklahoma	2,100
Arkansas	3,000	Massachusetts	5,000	Oregon	
California	4,000	Michigan	4,000	Pennsylvania	7,000
Colorado	2,400	Minnesota	4,500	Rhode Island	4,000
Connecticut	2,500	Mississippi	2,750	South Carolina	2,400
Delaware		Missouri	2,400	South Dakota	2,400
Florida	3,000	Montana	3,000	Tennessee	3,600
Georgia		Nebraska	2,000	Texas	2,700
Idaho		Nevada		Utah	
Illinois	4,000	New Hampshire	1,800	Vermont	
Indiana	2,500	New Jersey	3,300	Virginia	3,500
Iowa	2,500	New Mexico	3,300	Washington	4,200
Kansas	3,000	New York	3,500	West Virginia	3,000
Kentucky	2,400	North Carolina	4,000	Wisconsin	4,000
Louisiana		North Dakota		Wyoming	
				Average	$3,220

A Bridge-Testing Locomotive

Testing bridges by loading with a gasoline locomotive of special design is a novel method introduced on the government railways of Switzerland. According to the *Railway Gazette*, London, the engine is of the 2-2-2 type, with a middle pair of 74-in. driving wheels and leading and trailing wheels 37 in. in diameter. Provision is made for transferring the load from these latter wheels to the drivers in order to give a concentrated load at any desired point. When thus adjusted the engine can be moved in either direction. The weight is about 36 tons, which in normal operation is distributed equally. To permit of testing light structures about 7 tons of the weight consists of movable blocks, so that the total weight can be reduced to 29 tons. A 10-hp. engine drives the locomotive, which can ascend grades of 2½ per cent, but for transportation the locomotive can be hauled by a regular train.

Flow in Tennessee Checked Against Hydraulic Formulas

Studies of These and Irrawaddy River Curves Indicate That Ganguillet and Kutter's Formula Does Not Allow Fully for Effect on *C* of Slope and Hydraulic Radius

By Benjamin E. Jones
Hydraulic Engineer, U. S. Geological Survey, Washington, D. C.

THE formulas proposed by Bazin and by Ganguillet and Kutter for the flow of water in open channels were based upon at least two assumptions that are open to question. Bazin, in proposing a formula for the coefficient C in Chezy's formula $V=C\sqrt{RS}$, assumed that C does not vary with the slope, and Ganguillet and Kutter in proposing their formula for C assumed that an increase in slope would increase C when the hydraulic radius was less than 1 m and would decrease C when the hydraulic radius was greater than 1 m. The measurements described in this article seem to show that, at least under certain conditions, both these assumptions are wrong.

In Chezy's formula for the flow of water in open channels all the variations due to changes of slope and hydraulic radius, as well as changes due to the differences in the roughness of the channel, are included in the coefficient C Ganguillet and Kutter's formular for C is

$$\frac{\frac{1.811}{n} + 41.6 + \frac{0.00281}{S}}{1 + \left\{ 41.6 + \frac{0.00281}{S} \right\} \frac{n}{\sqrt{R}}}$$

in which n expresses the effect of roughness of the channel.

They make an allowance for the effect of change in slope and in hydraulic radius, so that the only unknown factor will be the roughness of the channel. In using

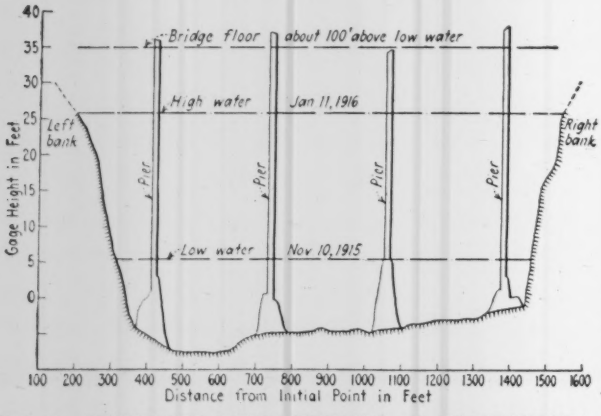


FIG. 1. TENNESSEE RIVER SECTION AT CHATTANOOGA

their formula it is customary to assume a value for n for a stretch of river channel and to use the same value regardless of change in slope or in hydraulic radius. Also in fixing the value of n the character of the channel alone is considered, the slope usually being disregarded so far as its effect on n is concerned. This procedure is correct only in so far as Ganguillet and Kutter succeeded in eliminating the effect of all factors except the roughness of the channel.

The measurements described below, which were made on a large river, show the effect of changes of slope and hydraulic radius under certain conditions on the factor n, which is supposed to represent only the degree of roughness of the channel. The information obtained has a bearing on the use of velocity formulas in computing the flow of water in large open channels, and if other experiments covering all the various conditions of their use can be made their results may show how to eliminate most of the sources of error in the application of the formulas.

TABLE I—SLOPE AND DISCHARGE MEASUREMENTS, TENNESSEE RIVER, CHATTANOOGA, TENN.

No.	Date	Stage, Ft.	Area Sq. Ft.	Hydraulic Radius Ft. R	Slope In Ten millionths S	Discharge, Sec. Ft.	Velocity, Ft. Per Sec.	Chezy C	Kutter N
1	Mar. 9, 1917	44 20	63,700	28.9	622	276,000	4.33	102	.029
2	Mar. 9, 1917	42.80	60,800	27.9	649	262,000	4.31	101	.029
3	Mar. 10, 1917	35.93	48,600	26.0	722	195,000	4.01	92	.032
4	Jan. 11, 1916	25.75	33,300	24.5	828	129,000	3.87	86	.0335
5	Mar. 31, 1917	23.38	30,100	22.6	842	113,000	3.75	86	.033
6	Feb. 5, 1918	22.14	28,500	21.7	793	99,500	3.48	84	.034
7	Jan. 15, 1916	20.57	26,800	20.8	825	94,000	3.51	85	.033
8	Oct. 6, 1915	18.58	24,500	19.4	795	81,900	3.34	84	.033
9	Oct. 7, 1915	16.55	22,000	17.9	763	65,400	2.97	80	.035
10	June 4, 1915	13 53	18,600	15.5	877	53,100	2.85	77	.035
11	May 10, 1915	13.32	18,300	15.3	796	48,200	2.63	75	.036
12	Mar. 29, 1918	13.23	18,200	15.2	947	51,700	2.84	75	.035
13	Sept. 9, 1915	*12.58	17,500	14.4	582	35,000	2.00	70	.0395
14	May 11, 1915	12.37	17,200	14.3	766	41,600	2.42	73	.037
15	May 8, 1915	*12.02	16,800	14.1	650	34,800	2.07	68	.0405
16	Apr. 13, 1915	11.61	16,200	13.6	858	39,300	2.43	71	.0375
17	June 18, 1915	11.28	16,200	13 5	774	36,200	2.23	69	.039
18	Apr. 16, 1915	11.26	15,900	13.4	776	36,000	2.26	70	.039
19	July 12, 1915	10.54	15,300	13.0	750	31,400	2.05	66	.041
20	May 8, 1915	10.45	15,000	12.7	744	30,500	2.03	67	.0395
21	July 13, 1915	9.99	14,800	12.5	754	28,700	1.94	63	.0425
22	June 2, 1915	9.85	14,500	12.3	755	27,300	1.88	61	.044
23	Apr. 7, 1915	9.64	14,200	12.1	698	24,100	1.70	59	.046
24	June 11, 1915	9 44	14,100	12.1	758	25,300	1.79	59	.045
25	May 31, 1915	9.15	13,700	11.8	690	22,100	1.61	56	.048
26	Sept. 15, 1915	*8.86	13,200	11.5	457	14,900	1.13	50	.057
27	May 10, 1916	*8.77	13,200	11.5	668	17,900	1.36	49	.056
28	May 5, 1915	8.76	13,200	11.5	717	20,700	1.57	54	.0495
29	Aug. 17, 1915	8.79	13,100	11.4	617	20,000	1.53	58	.046
30	June 14, 1915	8.53	13,000	11.3	679	19,300	1.48	53	.050
31	Apr. 30, 1915	8.50	12,900	11.3	684	18,800	1.46	53	.051
32	May 3, 1915	8.05	12,500	11.0	788	19,200	1.54	52	.051
33	Jan. 14, 1918	8.00	12,400	10.9	506	11,500	0.93	40	.067
34	Aug. 16, 1915	7.66	12,000	10.5	839	18,400	1.53	52	.050
35	Oct. 14, 1916	7.42	11,600	10.2	582	11,200	0 97	40	.067
36	July 30, 1915	7.17	11,400	10.1	765	15,100	1.33	48	.054
37	Aug. 14, 1915	6.10	10,200	9.1	901	13,400	1.31	46	.055
38	Aug 4, 1915	5.95	10,100	9.0	928	12,800	1.27	44	.057

* Flashboards on dam.

The accompanying tables and diagrams give the results of 38 slope and discharge measurements. Curves have been drawn to show the variation of C and n due to differences in slope and in hydraulic radius. The measurements made at the same stage but with different slopes produced by the use of flashboards are of particular interest.

The discharge measurements shown in Table I were made several years ago by Warren E. Hall, district engineer, United States Geological survey, in a study of the discharge of rivers of variable slope. They were made with a small Price current meter from a bridge on the Tennessee River at Chattanooga, Tenn. The area and velocity for all the measurements are referred to the section at this place which is shown in Fig. 1. The slope was obtained from two gages, one at the measuring section and the other at a bridge seven miles upstream. The normal or usual fall in this distance is about 3 ft. Backwater from Hales Bar dam, 33 miles below the lower gage, extended above

both gages, and flashboards placed on the dam at low water decreased the slope for some of the measurements. (See Fig. 2).

Table I shows the results of the discharge measurements on the Tennessee River, the slope at the time each measurement was made, and the value of C in Chezy's formula and of n in Ganguillet and Kutter's formula. Fig. 3 shows the value of C plotted against the hydraulic radius and the variation from the value

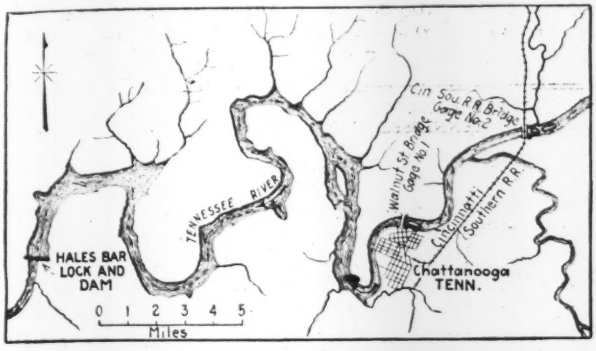

Cin. Sou. R.R. Bridge Gage No. 2
Walnut St. Bridge Gage No. 1
TENNESSEE RIVER
Cincinnati Southern R.R.
HALES BAR LOCK AND DAM
Chattanooga TENN.
0 1 2 3 4 5
Miles

FIG. 2. GAGING STATION SITES AT CHATTANOOGA
The distance between the two gaging stations is about 7 miles. The reservoir formed by the Hales Bar Dam extends to a point at or near the longer island above Gage No. 2, a distance of 42 miles.

of C as computed by Ganguillet and Kutter's formula for $n = 0.035$. The value fixed for $n = 0.035$ was selected as best fitting the results of all the measurements. For comparison, the results of measurements made on Irrawaddy River, at Saiktha, Burmah, are given in Table 2 and Fig. 4. The results of these measurements are taken from Hering and Trautwine's translation of Ganguillet and Kutter's work.

The extent to which the values of n and C obtained in these experiments could be applied to other similar channels depends, of course, on the relation that the cross section at the bridge on Tennessee River bears to the average cross section of the whole stretch of channel involved in the measurements. The area of the piers of the bridge is a very small percentage of the area of the stream, (Fig. 1.) and on the whole the area at the bridge doubtless represents fairly well the cross section of the seven miles of channel. The addition of the area of the piers, which increases the cross section of the stream, gives somewhat lower values for C, but the slope and shape of the curve are the same. The curve shown in Fig. 3, therefore, shows the variation in the value of C under the conditions of slope and stage indicated and also the departure from C as computed by Kutter's formula.

As the minimum hydraulic radius for any of these measurements is 9 ft., the slope and hydraulic radius have proportionately greater effect on the value of C and n than they would have at lower stages, when the effect of the condition of the channel itself would be greater. Figs. 3 and 4 shows that for low velocities C is likely to vary greatly, even in the same channel, but the slope formulas are used principally in designing canals and estimating flood discharge. For the design of canals, in most of which the velocity is low, ample data on the value of n and C are available. During floods the velocity is usually so high that the large error possible at low velocities need not be considered except so far as the cause of the variations at low rates of discharge may have the same effect at higher rates.

For stages on the Tennessee River when the hydraulic radius is greater than 14 ft. the results of the measurements follow more nearly the results as computed by Ganguillet and Kutter's formula, but even here the increased slope and hydraulic radius and resulting increased velocity affect the value of C and n.

As already stated, Ganguillet and Kutter assumed that for a hydraulic radius greater than 1 m. C would decrease as the slope increased, but on the Tennessee River C increased with an increase in slope when the velocity was low, although the hydraulic radius was between 9 and 14 ft. The value of C indicated by measurements 23, 24, 25, and 30, which were made with flashboards on the dam, and by measurements 31 and 36, all of which show a small slope, was considerably lower than that indicated by other measurements made practically at the same stage but with a greater slope owing to the absence of flashboards. Bazin assumed that C does not vary with the slope and based his formula on that assumption, but there seems to be no other cause for the changes in C shown by the measurements on the Tennessee River. Measurement 33, with a hydraulic radius of 10.9 ft. and a slope of 0.0000506, shows a value of 40 for C, whereas measurement 34, with a hydraulic radius of 10.5 ft. and a slope of 0.0000839, shows a value of 52 for C. As the velocity increases an increase in slope has less effect on C, as shown by measurements 12, 13, 14, and 15. Measurements 13 and 15, with lower slopes, show only slightly lower values for C than measurements 12 and 14. At the higher velocity of 4 ft. a second represented by measurements 1, 2, and 3, which were made at flood stage, increase in slope seems to decrease the value of C, but this effect is not shown so conclusively as the opposite effect is shown for the lower velocities.

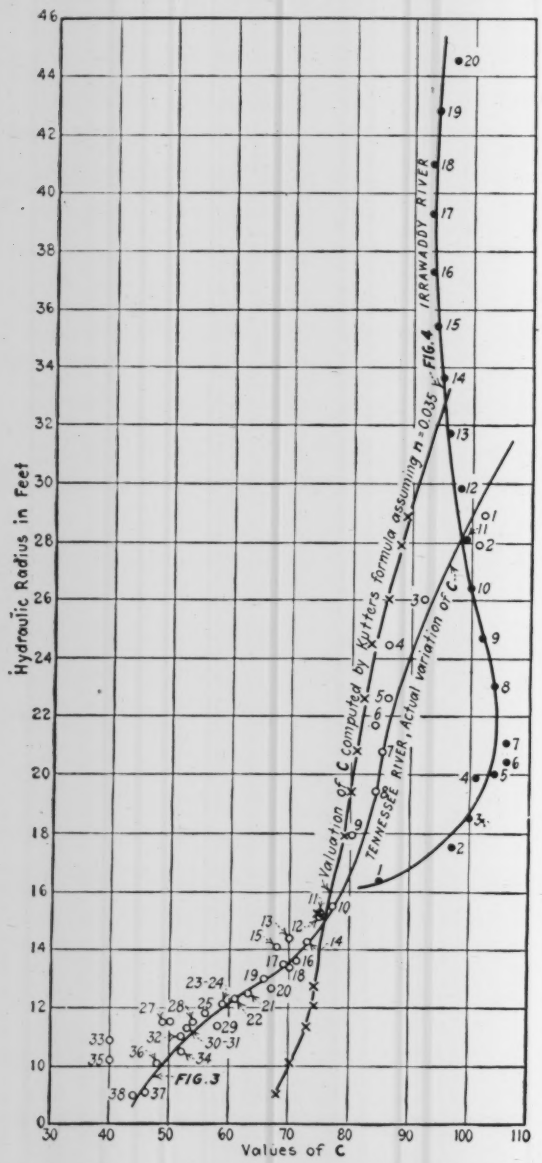
TABLE II—SLOPE AND DISCHARGE MEASUREMENTS, IRAWADDY RIVER AT SAIKTHA, BURMAH.

No.	Hydraulic Radius In Feet R	Slope in Ten Millionths S	Velocity, Feet Per Second V	Chezy C	Kutter n	Surface Width Feet
1	16.28	86	1.007	85.1	.0420	3,395
2	17.52	129	1.459	97.0	.0357	3,528
3	18.49	172	1.783	99.5	.0336	3,710
4	19.88	215	2.083	100.7	.0328	3,930
5	19.99	258	2.360	103.9	.0304	4,208
6	20.40	301	2.620	105.7	.0292	4,605
7	21.13	344	2.857	105.9	.0286	4,780
8	22.97	387	3.091	103.6	.0293	4,820
9	24.70	430	3.321	101.9	.0300	4,859
10	26.42	474	3.548	100.3	.0306	4,899
11	28.11	516	3.771	99.0	.0310	4,938
12	29.80	560	3.993	97.8	.0315	4,970
13	31.68	603	4.213	96.4	.0320	4,976
14	33.57	646	4.432	95.2	.0325	4,982
15	35.44	689	4.652	94.2	.0330	4,988
16	37.31	732	4.874	93.3	.0336	4,994
17	39.16	775	5.110	92.8	.0337	5,002
18	41.01	818	5.382	92.9	.0336	5,011
19	42.82	861	5.717	94.2	.0327	5,025
20	44.47	904	6.147	97.0	.0314	5,045

Measurements of the Irrawaddy River, however, indicate the same effect. For a hydraulic radius between 16 and 21 ft. on Irrawaddy River the value of C increases rapidly with that of S and R. For a hydraulic radius above 21 ft., S and R continue to increase, but C decreases slightly and then remains fairly constant. Evidently the tendency of C to increase with R for values of R above 21 is counterbalanced by its tendency to decrease with an increase in velocity due to the increase in R and S. Measurement 7, on the Irrawaddy River, which was taken about at the point where C stops increasing, was made at a velocity of 2.86 ft.

Measurements 13, 14, and 15 on the Tennessee River were made at velocities of 2.0 to 2.4 ft. a second. Hence for these two rivers it seems that for velocities up to 2.5 or 3 ft. a second an increase in S is accompanied by an increase in C. For higher velocities C tends to decrease as S increases.

Although general conclusions can not be drawn from only two sets of measurements it seems fairly certain that the slope and hydraulic radius, through their influence on velocity, do affect the value of C, and that this effect is not fully taken into account by Ganguillet and Kutter's formula.


Hydraulic Radius in Feet
Values of C
IRRAWADDY RIVER
FIG. 4
Valuation of C computed by Kutter's formula assuming n = 0.035
TENNESSEE RIVER, Actual variation of C
FIG. 3

FIGS. 3 AND 4. VARIATIONS IN C, TENNESSEE AT CHATTANOOGA AND IRRAWADDY AT SAIKTHA, BURMAH

Curves show that n and C change greatly with hydraulic radius. The difference in the shape of the upper ends of the two curves is probably due to the fact that the slope of the Irrawaddy increases with the stage, while the slope of the Tennessee decreases slightly at the higher stages.

On the Tennessee River C increased with an increase in slope for velocities below 2.5 ft. per second. For higher velocities C increased with the hydraulic radius, although the slope remained constant, or even decreased. On the Irrawaddy River C remained fairly constant, although both slope and hydraulic radius increased. A more rapid increase in slope than that on Irrawaddy River would probably cause a decrease in C.

These experiments afford no data to indicate the effect of changes of slope and hydraulic radius at low stages, when the hydraulic radius is small and when the effect of slope is generally slight compared to the effect of roughness of channel. The slope should be considered, however, in selecting the value of n when the hydraulic radius exceeds 6 ft. especially in using a value of n determined at a low stage of the stream to compute the discharge at flood stage.

At present there are very few measurements of slope and discharge covering a wide range of stage for a single stretch of channel which can be used in studying the effect of changes in stage and slope on C or n and until the results of a number of such series of measurements are obtained computations of flood discharge based on Ganguillet and Kutter's or any other formula for C are subject to any error which may result from disregarding the effect of slope and hydraulic radius on C and n. The error thus caused, though probably small in some computations, may be large in others, and all computations should be considered doubtful until more information is available.

The measurements desired could easily be made in connection with work at gaging stations, for convenient stretches of river could be selected and gages installed for use in determining the slope. After that it would only be necessary to read these gages at the time current-meter measurements were made in order to obtain the slope. It is hoped that more measurements of this kind will be made and published, for although Ganguillet and Kutter's formula is very good, engineers agree that, for flood estimates at least, it must be used in connection with slope and discharge measurements that will indicate its limitations and the modifications that may be necessary to make it fit any individual problem.

Small Contractors Clear Reservoir at Lowest Cost

The last of the clearing in the 1,800-acre area that will be submerged by the Hetch Hetchy dam in California has recently been completed and the 22,000 cords of wood cut from this area is being used for power purposes in the construction of the dam. In letting contract for the clearing work the bids of large firms who figured on the entire job were three to four times as much as the bids of individuals who contracted for clearing small areas and who gave their personal attention to the work. Contracts of the latter class covering 3- to 30-acre tracts were awarded at prices ranging from $25 to $75 per acre. In addition to the contract price an allowance per cord for wood corded at the river bank in 4-ft. lengths was made as follows: cedar, $2.50, pine, $3, oak, $4. The city of San Francisco, for whom the dam is being built, advanced these small contractors equipment and supplies from stock at the dam site, later deducting the charge from payment on the contract. Out of a total of 86 contracts only 4 were abandoned.

Rules and Regulations for Operating Iowa Sewage-Works

Recommendations of Committee of Sanitary Engineers Were Adopted by State Board of Health—185 Plants in Iowa

SEWAGE-WORKS in Iowa are supposed to be operated in accordance with a set of rules and regulations adopted as a guide recently by the State Board of Health. The rules, which are given below somewhat abridged, were written and recommended to the board by a committee of sanitary engineers composed of the following: H. V. Pedersen, John H. Dunlap, Prof. C. S. Nichols, Prof. R. S. Wallis, Lafayette Higgins, Sr., C. H. Currie and M. G. Hall. According to Mr. Pedersen, civil and sanitary engineer of the board, the rules do not cover in detail all the things that might be done for certain specially constructed plants but are meant to cover all works in a general way that are most common in Iowa. There are 185 plants in Iowa.

By-Passing—No raw or unsettled sewage shall be by-passed either at the inlet or from the siphon chamber except when absolutely necessary. Whenever by-passing becomes necessary the length of the time and the reason for it should be reported to the State Board of Health.

Grit Chambers—Grit chambers shall be flushed out or cleaned out after every storm. In time of dry weather they shall be cleaned out whenever the contents obstruct the flow of the sewage or tend to become a nuisance. Such cleaning might be necessary every week. Contents of grit chambers shall be either hauled away and buried or dried upon a sludge bed and then disposed of in the most convenient manner that will not cause a nuisance. In case the grit chamber has a system of screens, these screens shall be cleaned thoroughly every day.

Septic Tanks—The contents of septic tanks shall be kept as quiet as possible. The solids which settle out may remain as sludge on the bottom of the tank, or rise to the surface and float as gas-lifted sludge or scum, or may remain partially on the bottom as sludge and partially on the top as scum. The accumulation of scum and sludge shall not be allowed to decrease the working depth of the tank more than 25 per cent. In general the scum and sludge shall be removed at least every six months, preferably in the spring and fall, or more often if a dark, flaky substance appears in the effluent. No naked lights of any kind shall be taken into any septic tank or compartments accessory thereto.

Imhoff Tanks—Do not allow sludge to accumulate on the side-walls, bottom or any other surface of the flowing-through chamber. In removing such sludge be careful to force it entirely through the slot in the bottom and into the digestion chamber. Any sludge rising to the surface shall be skimmed off and dumped into the gas vents. Any oily material shall be skimmed off and buried. Break up any gas-lifted sludge in the gas vents frequently to release the entrained gases and allow the sludge to re-settle. Where foaming in the gas vents cannot be controlled consult your operating engineer or the sanitary engineer of the State Board of Health. Remove sludge from the bottom of the tank at least every six months, preferably in the spring and fall, or more often as conditions may demand. The removal of small amounts of sludge every four to eight weeks is frequently advantageous and is necessary if the digestion chamber is too small. Care should be taken to remove only the well-ripened sludge. Never allow the sludge in the sludge chamber to rise closer to the slot than 20 in. Make sure late each fall, when the sludge is removed, that the storage capacity of the sludge chamber is sufficient for the storage of the winter sludge. Always backfill the sludge pipe with water or settled sewage, and flush out the pipe running to the sludge bed after the sludge has been withdrawn. No naked light should be taken inside of a closed or housed Imhoff tank.

Dosing Chamber—Any appreciable amount of sludge accumulating in the dosing chamber, which will in any way find its way into the siphons and be discharged upon the filter beds, shall be removed to the sludge bed when available or be disposed of in some other effective manner so as not to become a nuisance.

Intermittent Sand Filters—Watch for wash-ins and repair immediately after they occur. Remove the sludge which gathers on the surface of the beds so as to maintain good operation at all times and thus prevent ponding. Never disturb the sand on the surface of the bed deeper than is necessary to break the scum, or sludge, and to obtain a good infiltration. Do not remove any sand unless necessary to prevent ponding. Under no circumstances shall the surface of the sand bed be plowed under or be mixed in any other way with the remainder of the sand. Keep the surface free from weeds and grass. In late fall prepare the beds for winter operation by piling or ridging the sand. Regulate the openings in the distributing troughs and pipes so as to secure a uniform distribution of sewage over the surface of the beds. Do not allow the filter beds to stand flooded. Sewage should never be passed directly to the underdrains by digging holes through the sand. Never add new sand which has not been approved by your operating engineer or by the State Board of Health. Repair a broken vent pipe immediately. Never permit a team, or heavy machine that will tend to compress the sand, to be driven over the sand beds.

Trickling Filters—The nozzles shall be kept clean so that the sewage spray may be evenly distributed. The filter medium must be kept free from surface mat or vegetable growth which may cause pooling. Distribution pipes and underdrains must be flushed out frequently so as to prevent any accumulation of putrescible organic matter.

Contact Filters—Care must be taken to see that the timed siphons, regulating the rest period, the filling and emptying period and the contact period, are working properly. Remove all the solid material or vegetable growth from the surface of the contact bed to prevent clogging or pooling. When oily matter or other difficult material clogs the contact filter below the surface it is necessary to replace the clogged filter stone with clean filter stone.

Sludge Beds—Sludge should be allowed to remain on the sludge bed until thoroughly dry. Dry sludge should be removed from the bed before more sludge is applied. In removing sludge from the bed be careful not to remove any more sand or other filter medium than is absolutely necessary.

Sampling and Testing—Fill the Imhoff conical settling glasses at the same hour each day with samples of the raw and settled sewage. After one hour read the cubic centimeters of settled solids and record them for future reference. For the relative stability tests take samples of the filtered sewage and the outlet stream below the outlet. Put about 150 c.c. of sewage in a glass stoppered bottle so that all air will be excluded. After adding with a pipette 0.4 c.c. of methylene blue solution the mixture should be kept at room temperature and should be observed regularly to determine how many days it will retain the blue color. Retention of the blue color for at least ten days is considered necessary.

General Caution—When working in manholes, or in any confined areas, around sewage-works, remember that much gas is held entrained in decomposing sewage sludge. When the pressure on the sludge is relieved from any cause, such gas may escape from the sludge in quantities sufficient to cause asphyxiation and may cause death in extreme cases.

Missouri-Kansas Water-Works Tax Treaty

A treaty between the states of Kansas and Missouri designed to facilitate the construction of new water-supply works for Kansas City, Mo., has been ratified by Congress. The treaty mutually exempts from taxation water-works improvements extending from one of the states into the other.

Municipal Improvements Society Discusses Many Problems

Abstracts from Papers on Separate Systems for Sewers and Storm Drains and on Garbage Disposal, and Committee Report on Street and Sidewalk Design, Read at Cleveland Oct. 2-6

Use and Abuse of Systems of Separate Sewers and Storm Drains

By Harrison P. Eddy
Of Metcalf & Eddy, Consulting Engineers, Boston, Mass.

SEPARATE sewers with few or no storm drains has become common practice in small communities and somewhat prevalent in the larger cities. This has been based, generally, on either real or fancied economic necessity. As it is rather unusual to make complete accurate estimates of cost of the two systems under consideration it may add interest to illustrate the subject by a case in which three plans were designed complete and estimates of cost of all three systems were based upon the lowest bid of contractors upon one of the systems. Estimates of cost of the three projects are given in the accompanying table:

COMPARATIVE ESTIMATE OF COST SEWERS UNDER THREE PLANS

	Cost of Sewers or Sewers and Drains	Cost of House Connections Work in Streets	Work in Private Property	Total Cost
Combined sewers	$476,625 (72.7%)	$56,425 (8.6%)	$122,600 (18.7)	$655,650 (100%)
Separate sewers and partial system of storm drains	$477,700 (68.7%)	$80,125 (11.6%)	$140,900 (19.7%)	$698,725 (100%)
Separate sewers and complete system of storm drains	$524,850 (67.2%)	$90,280 (11.6%)	$164,900 (21.2%)	$780,030 (100%)

The estimates indicate that under the conditions of this case the combined system would be substantially cheaper than the system of separate sewers and a partial or incomplete system of storm drains, and considerably less expensive than the complete systems of separate sewers and storm drains.

Causes of Misuse of Separate Sewers and Storm Drains—The principal causes of the misuse of separate sewers and storm drains may be grouped in six classes as follows:

1. Ignorance of the purpose and objects of the sewers, due to lack of proper instructions from those designing the systems, or to frequent changes in administration, or to the loss of records and drawings.
2. Indifference of municipal officials.
3. Lack of authority to enforce suitable regulations.
4. Favoritism or "pull" has undoubtedly played an important part in permitting the making of incorrect house connections.
5. Surreptitious connections. In many cases, particularly in times of high cost of construction work, building owners undertake to make certain improvements or repairs directly, or through the employment of journeymen mechanics.
6. In a relatively few instances misuse has undoubtedly been due to incorrect connections made through error.

Remedies for Misuse of Separate Sewers and Storm Drains—Great care should be exercised in the selection of the type of sewer system to be installed. It should not be assumed that separate sewers are more advantageous, but conclusion should be reached only after careful study of all the conditions including comparative estimates of cost. In making such studies due weight should be given to the value of the opportunity for disposal of roof water into sewers and to the inequity of affording such facilities to a portion of the property owners and withholding them from others. It may be accepted as a fact that residents will not tolerate standing water in their cellars. In thickly settled communities water cannot be allowed to flow over sidewalks to the street gutters, and, at least in the northern portion of the country, roofs and areas cannot satisfactorily be drained into gutters by pipes passing under sidewalks. Topography, character of soil, climate, present and prospective density of population, frequency and intensity of precipitation, as well as conditions influencing the problem of sewage disposal, are among the important considerations bearing upon such a selection.

Discussion—A. P. Folwell, New York City, summarized the results of a questionnaire on the control and abuse of sewer connections, which showed much diversity of practice as to the admission of street and roof water to sanitary sewers and also as to the admission of industrial wastes to sewers. T. C. Hatton raised a point as to conditions found by cities that annex or without that provide sewerage facilities for outlying districts, such as no exclusion of roof water from sanitary sewers. A speaker said that two-thirds of Lancaster, Ohio, is sewered on the combined plan and the State Department of Health refuses to grant permits for extensions except for separate sewers. This means increased assessments over those heretofore made, with resulting complaints from property owners. S. A. Greeley said he knew of a half dozen towns with populations of from 10,000 to 40,000 where sewer extensions are at a standstill because existing sewers are overcharged and those on these sewer lines protest against further overcharging.

* * *

Some Garbage Disposal Troubles and Remedies

By Samuel A. Greeley
Of Pearse, Greeley & Hansen, Consulting Engineers, Chicago, Ill.

REFUSE collection and disposal in American municipalities has been characterized by some well informed observers as a mess of mistakes. They see a wide variety of disposal methods in use and in some cities apparently abrupt changes from one method to another, sometimes involving the abandonment of seemingly useful and expensive going plants. They see large and costly disposal works built and operated for a few years and then abandoned to gradual disintegration. The city engineer of Gary writes that "our incinerators have been out of service for seven years and would have to be rebuilt to make them serviceable." Los Angeles, after seven years operation of a garbage reduction plant, has abandoned it (at least for the present) in favor of hog feeding. Baltimore, after a few years of hog feeding for garbage disposal, has turned again to reduction; and Buffalo, with hog feeding established for a while has recently taken bids for incineration [of material rejected by pigs; tentative project—Editor]. The large reduction plant at New York and a group of incinerators at Seattle, have all been abandoned, New York dumping at sea and Seattle dumping on land in "sanitary fills."

Fundamental Considerations — If service to householders and proprietors be held of first importance, with economy of operation following closely, then the disposal of refuse is of somewhat less importance than the collection service.

Much has been accomplished through motorization, as at Los Angeles, Montclair, Minneapolis and elsewhere, although final economies are not yet established. Further progress toward economy has resulted through the use of the tractor-trailer and the establishment of transfer stations which permit the decrease of the expensive collection haul with an increase in cheaper quantity haul.

A Yard Stick for Haul—Let me assume that a collection unit of two men can make collections of house refuse at the rate of 75 pick-ups per hour. If the unloading point is so located as to require four hours of haul, each such collection unit will serve around 300 houses per working day. If the team haul be reduced to three hours, the number of pick-ups (or houses served) will be increased to 375 per day.

In larger cities, the team haul can be supplemented by quantity haul. If the team haul (averaged with collection service) costs $4.50 per ton, quantity haul may cost only a third time as much or about $1.50 per ton. What then is the economical relation between team haul and quantity haul? Obviously this can only be determined after a careful study of all the local conditions, including the rate of collection work, the travel of teams and motors, the available locations for transfer stations, the life and location of dumps and disposal plants, rates of wages and other similar considerations. But the yard stick for haul is the number of houses to which collection service can be given by a unit of collection and haul equipment.

Wha About Failures—As commonly considered the term "failure" as applied to refuse disposal projects, refers to the abandonment of a finished disposal plant representing invested capital and ready for operation. If a considerable sum of public money is put into the works and these works are not used but are allowed to disintegrate, something is certainly wrong. Such upsets, however, are not the real failures. They are the symptoms of a deeper trouble. I offer for your consideration some of the causes of these upsets and plant abandonments as follows:

1. A failure, in the first place, on the part of city officials, to appreciate the true measure of a refuse disposal project. Communities should understand that the first objective is clean houses, with the construction of a disposal plant second.
2. A failure to secure and adopt a general plan for all the refuse disposal work, including proper ordinances and kitchen cards, collection equipment and management, transfer stations, hauling equipment, dumping facilities, etc.
3. Failure to profit by co-operation with experts of independent judgment who can bring to the local problem the helpful experiences of other situations.
4. Failure to operate disposal works with reasonable skill and economy.

* * *

Report of Committee Upon Street and Sidewalk Design

BY E. R. CONANT, G. A. CRAYTON AND S. Q. CANNON

IT MIGHT be said that only of comparative recent date has the subject of street and sidewalk design been attempted in a scientific manner, for comparing the answers to the committee's questionnaire it is noted that in older cities, with the exception of recent layouts, street design is far behind that in the newer cities.

Widths of Roadways—Replies to the question on this subject show conclusively that the width of roadways should be based on the number of lines of traffic to be accommodated and while but a very few cities report that they give consideration to the density of traffic to aid them in establishing the necessary number of lanes, yet the Committee feels that a study of the present and prospective amount of traffic is very important.

Traffic Lane Widths—Analysis of the replies received would indicate that for each line or lane of traffic a width of from 7 to 8 ft. is necessary for motor vehicles parked at the curb and from 8 to 10 ft. for vehicles moving, with a somewhat greater average width in business than in the residential sections. Space for street car tracks should be from 8 to 9 ft. for single and 18 to 20 ft. for double track.

Alleys—In a city laid out on the rectangular system, alleys are of special value, since in them may be placed sanitary sewers and unsightly poles. Alleys also afford access for deliveries to residences, for the collection of garbage and rubbish and to garages on the back of lots. Alley widths should not be less than 18 ft.

Width of Sidewalks should be determined by the intensity of traffic. From the replies received it appears that the best practice is a width of from 5 to 6 ft. for residential sections, and from 10 to 15 feet for business sections.

Grass Plats afford space for trees, poles and hydrants and widening of the traveled roadway without the acquisition of additional land. Where trees are planted, grass plats should not be less than 5 ft. wide. A number of cities allot from 1 to 2 ft. of grass space between the sidewalk and the property line, when the grass plat is next to the curb.

Safety Zones—The general practice is to paint the pavement with lines which designate the area or zones where vehicular traffic must give way and look out for foot traffic. These lines may mark zones where street cars stop or they may mark crossings for foot traffic from one sidewalk to the other. The zones where street cars are approached are usually 6 ft. in width and of proper lengths and a safety walk from the middle of the zone to the sidewalk on the side of the street where zone is marked off is advantageous. In a number of cities a 4-in. platform of plank or concrete is constructed. In other localities posts or stands connected with ropes are installed.

Sidewalk Crossings—There is a tendency to get away from the step at the curb to the street at street intersections, especially where the foot traffic is heavy. Such steps should not exceed 6 in.

Radii of Curbs at Street Corners—Before the introduction of the automobile and motor trucks, a 6- or at most 8-ft. radius curb was considered adequate. Under present conditions in new layouts the radius of the curb in residential sections should not be less than 10 ft. In business sections, from 10 to whatever limit can be introduced according to width of sidewalk and roadway. For alleys, 5 to 6 ft. radius is sufficient.

Catch Basin Inlets—Catch basins should be connected directly to the sewer at the manholes, by means of an individual pipe. They are generally located at street intersection, but where necessary to increase the number intermediate inlets may be located in the middle of the block. Modern practice provides for the entrance of the water into the catch basin through [ungrated] openings either cut out of the curb or better through openings in castings set in the sidewalk flush with the curb.

Street Crowns—Generally the grade varies directly with the width and inversely as the function of the grade of the street. A quite general practice is to fix the crown from 1/60 to 1/100 of the width, depending on the grade and character of service. Analyzing the answers to our questionnaire, the following appears to be the general practice where grades of streets are normal and where the surfacing of the pavement is concrete, brick, bituminous or surfacing of light nature: For street width of 20 to 22 ft., the amount of crown 4 in.; 24 to 28 ft., 5 in.; 30 ft., 5½ in.; 32 to 42 ft., 6 in.; 45 ft., 7 in.; 48 to 52 ft., 8 in. For rough surfaced streets, such as granite block, the crown should be increased from 20 to 25 per cent; for macadam or gravel, 50 to 75 per cent; and where the grades of the street exceed 4 per cent the amount of the crown can be reduced in proportion to the grade, from 20 to 40 per cent.

Gutters—Where very flat grades are encountered the slope of the gutter is often made much steeper than the general crown of the street and in a number of instances cited the slope may be as heavy as 1 to 3 in. to the foot.

Lamp Posts, Poles and Hydrants—In many cases poles, hydrants or posts are set just back of the curb but a better practice would be to have them set back from the curb a sufficient distance so that vehicles in parking will not hit them. This need not be more than 1 or 2 ft.

Discussion—Of the 23 committee reports and papers on streets, pavements, and sewers listed for the two sessions on Wednesday this by Mr. Conant was the only one that elicited much discussion. Several speakers favored direct inlets to storm sewers rather than catch basins, except for special conditions. Radii for curbs at corners received considerable attention, with special attention to the needs of automobiles. Two or three advocated compound curves at these corners, particularly at intersections of wide and narrow streets. A width of 20 ft. for alleys was urged by one speaker, and a concave section instead of a crown for alleys was reported by two members. Related to this general subject was a paper on Crowns of Streets and Highways, by G. A. Crayton, Pierre, S. Dak., who proposed a low crown composed of two straight lines from the curb to near the center, joined by a short curve.

Engineers Discuss Licensing

Letters Commenting on Editorial Discussion Published in Engineering News-Record July 6

With this installment is concluded the publication of comment on the editorial discussion of licensing that appeared in the issue of July 6. Other extracts from the letters that have reached us on the subject appeared in the issues of Aug. 31 and Sept. 21.—EDITOR.

George F. Swain

Consulting Engineer; Professor of Civil Engineering, Harvard Engineering School; Past-President, Am. Soc. C. E.

I entirely agree with you that the question of licensing is a public, and not a professional question. Furthermore, I have always been opposed to laws requiring the licensing of engineers. I think we have too much legislation anyway and if we would let things alone we should get along much better. Many people are being led to think that the legislature can cure almost any evil, but it is a fallacy.

I can see no public good that would be accomplished by licensing engineers. The qualifications of a man cannot be prescribed in a way to do justice. Licensing would not, in my opinion, promote public safety. Most of our states already have public commissions dealing with the various functions in which engineering is applied, such as public utilities, public health and building construction. The commissions dealing with those subjects are empowered to employ engineers and they do so. We do not need any more protection.

Licensing would simply complicate matters. An engineer practicing in different states would be obliged to obtain a license in each state. Those who grant the license, or who pass on his qualifications would, in many cases, be far inferior to the applicant himself. No rules could be made which would cover this matter adequately and justly. No diploma from a technical school is a guarantee of ability to construct safely and properly, nor is membership in any engineering society.

I entirely agree with your second principle that if the state undertake to vouch by license for the technical qualifications of an engineer, it should define accurately the type of engineering work it has found him competent to undertake. I do not think, however, that the state, or any state examiner, or any rules that can be formulated would insure the competence of those who might receive a license.

I also agree entirely with your third principle that any licensing requirements should apply to those engineers only who are called upon to bear ultimate technical responsibility. I also agree with your fourth, fifth and sixth principles. Indeed, I think you have covered the subject very well in your editorial.

It would be apparent from what I have said that I lay the main stress on your fourth principle, that licensing is not required for the protection of the public.

I may add that I believe that most of the agitation in favor of licensing originated in the selfish desire on the part of some individuals to promote their own individual prospects. I feel very sure that if licensing is practised, many engineers would be licensed and will obtain engineering work, who would not otherwise be called upon to do that work. They will obtain a fictitious guarantee of ability which will deceive rather than protect the public.

* * *

Charles M. Spofford

Consulting Engineer; Professor of Civil Engineering, Massachusetts Institute of Technology, Boston, Mass.

The editorial in your issue of July 6, entitled "A Rational Approach to the Licensing Problem," presents the subject of the licensing of engineers in an illuminating manner and with conclusions that seem inescapable.

Experience in Massachusetts, where a licensing bill was introduced into the legislature in the 1920-21 session, indicated, to put it mildly, no urgent demand on the part of the public for its passage and the committee to which it was referred did not think it necessary to report the bill. The writer has seen no indications that as yet either the public or the engineers of Massachusetts have suffered from the lack of such legislation.

It is to be regretted that the American Engineering Council in its recent report neither reached a conclusion upon the wisdom of licensing nor set forth the fundamental issues with the clearness displayed in your editorial.

* * *

Kenneth H. Osborn

Secretary, The Osborn Engineering Co., Cleveland, Ohio

I have read over the editorial discussion entitled "A Rational Approach to the Licensing Problem," published in your issue of July 6, and found it very interesting.

In it I find clearly stated a great many of the ideas on the subject of licensing that have always been in my thoughts when this subject was under discussion. I feel that you have brought out quite clearly the shortcomings of the licensing idea and the defects which are likely to be present in any licensing law. Although I have listened to considerable discussion on the subject of licensing and realize that there is a very strong sentiment in its favor, I have never been convinced that there was anything to be gained by a license requirement, and from my own experience I feel that it is little more than a nuisance to the engineer who practices in several states. I fail to see where either the public or the profession has gained anything by the proceeding.

I find a number of engineers who favor the enactment of license bills simply with the thought that if they do not pass one satisfactory to the engineer, either through the architects or through the work of state legislatures, who have not studied the problem, bills will be enacted which are unsatisfactory to the engineer. Since I am not in favor of such bills at all I feel that a better attitude is simply to watch the state legislatures to see that no unsatisfactory bill is passed rather than to insist on the passage of one which is considered unnecessary.

* * *

W. H. Courtenay

Chief Engineer, Louisville & Nashville R. R., Louisville, Ky.

The editorial is the best discussion of the subject that I have seen, and the six principles which are formulated in it are good. I particularly concur with the first principle that licensing must be justified wholly on the grounds of the public welfare, and not at all on that of professional advantage.

So far as my information goes the greatest activity in an effort to prevail upon state legislatures to pass laws requiring that engineers be licensed has been by engineers, and in their interest, and not in the interest of the general public.

Large public service corporations, many of which have property of value in a number of different states, have engineers continually in their employ. These corporations can be relied upon to employ men, responsible for the engineering work done, who are competent, and who have the work done with reasonable economy, for such corporations are vitally interested in the safety of their structures and in avoiding wasteful methods.

It is very questionable whether legislative requirement that engineers be licensed before they can practice engineering is productive of any beneficial results.

* * *

George Gibbs

Consulting Engineer, New York.

I have read the editorial discussion on licensing which appeared in *Engineering News-Record* of July 6, with a great deal of interest. It seems to me to cover the subject

admirably. I have never been in favor of the form of licensing which has been adopted in our state, and in general my reasons for objecting to it are the same as you so well bring out in your editorial.

In lieu, therefore, of writing a dissertation on the subject, I would endorse the summarized principles of the editorial of July 6, except, perhaps, for Number 3, which I think will be difficult to incorporate in a practical way in the license. "Technical responsibility" is rather a loose term and varies enormously in degree with the character of the job and the form of administration.

* * *

Morris Knowles
Consulting Engineer, Pittsburgh, Pa.

Everyone seems too prone to leave the solution of so difficult and abstruse a subject to someone else. Many of us have been willing to drift with the tide and accept that which seems to be the inevitable, viz., that licensing will come and so try not to stem the stream but direct the current. It has needed an editorial such as that appearing in the issue of July 6 to arouse the thought of the profession, and the wonder is that so few are aroused. We have for a long time needed the clear-cut expression of fundamental principle.

There ought to be a general agreement with most if not all of the principles stated in conclusion. There can be no doubt, however, that licensing, if to be justified at all, must be upon the ground of public welfare. But in most discussions this seems to have been forgotten and clannish or group advantage—even approaching trade unionism—seems to have predominated in actual sentiment, even if still covered up in the submerged undercurrent of thought. It is a fair question, however, whether public health, safety and welfare are not better conserved and protected, after all, by the effective and wise administration of just and adequate laws prescribing results and limiting conditions, rather than by placing the sovereign seal of approval upon personal fitness and judgment by some form of licensing.

Your analysis of the differentiation of the professional engineer from the doctor and lawyer is apt and to the point. Certainly the doctrine of *caveat emptor* applies more in the case of the former than for the other learned professions. Again the suggestion that licensing should be a requisite, if at all, for principals and not for subordinates, is a point well taken. And the need for definition of abilities in selected and even narrow lines is quite apparent; for the title "Licensed Engineer" conveys no information as to special ability and fails to indicate whether the licensee is equally qualified to direct the construction, of either a rolling mill or a filter plant.

Your editorial has performed a real service and it is to be hoped that it will stimulate thought, discussion and action.

Bulk Cement Deterioration Less Than in Bags

Deterioration of cement stored in bulk is less than in bags, owing to the smaller area exposed, according to Serial 2377, published by the U. S. Bureau of Mines. The conclusion is the result of an investigation to determine the cause of deterioration of portland cement during storage and transportation. Hydration takes place only at the exposed surface, and the bulk of the cement is unaffected. Cement transported in bulk must be shipped in a tight, closed car, and must be protected from moisture during loading, shipping, and unloading, preferably it should be used immediately after unloading at the point of destination. This practice is now followed by several manufacturers and where conditions are suitable it is becoming more common as its advantages are seen. Shipping in bulk effects a saving by eliminating the use of bags—which is an important item in the cost of cement—and it should also permit a saving in freight rates.

Colorimetric Test for Concrete Sand Studied

Limitations Found in the Standard Test for Organic Impurities in Studies by Bureau of Public Roads

By Charles E. Proudley
Junior Assistant Testing Engineer, U. S. Bureau of Public Roads, Washington, D. C.

THERE is no doubt that much harm is sometimes done by the presence of certain organic impurities in concrete sands, but the reliability of the present colorimetric method of indicating such impurities (Am. Soc. T. M. Standard C 40-22) is a matter subject to varying opinions. The many organic substances which may occur in sand and gravel deposits, their individual or collective influence on the behavior of these materials in portland cement mixtures and their peculiar reaction with the test reagents are subjects which cannot be considered here. Suffice it to say that any difference between the character of the substances is very difficult to determine and that all substances do not act alike on the sand mortars.

During the past few years the Abrams-Harder colorimetric test has been made on a great number of sands received by the Bureau of Public Roads testing laboratory from practically every section of the United States. For the purpose of this article 160 normally graded sands were selected, that is, sands which according to general observations should give a mortar strength at least equal to standard Ottawa sand briquettes. Their gradings were within the following limits:

Total retained on:	Per Cent
20-mesh	20-50
50-mesh	50-90
100-mesh	95+

A complete description of the colorimetric test as made on these sands and the color scale with which comparisons were made is given in the *Proceedings* of the American Society for Testing Materials, Vol. XIX, Part I. The strength ratios were found in the usual manner, a description of which may be found in U. S. Department of Agriculture Bulletin 949. With the results of these tests, the sands were classified according to color plate number and change in strength ratio from 7 to 28 days of the various materials.

TABLE I—APPARENT EFFECT OF ORGANIC MATTER ON STRENGTH RATIO AT 7 DAYS

Color	Strength Ratio: Over 100%	Strength Ratio: Under 100%	Total
Plate I	33	3	36
Plate II	42	5	47
Plate III	30	11	41
Plate IV	12	11	23
Plate V	11	2	13
	128	32	160

It will be seen in Table I that of the total number of sands considered (160), there were only 32 which failed to show 100 per cent strength ratio. Realizing that the character of the sand particles frequently influences the strength, each of the sands was examined and wherever feldspar or other minerals generally considered weakening were found they were noted. It is quite interesting, therefore, to observe from Table II that 56 per cent of those below 100 per cent contain objectionable minerals, whereas less than half that amount is found among those of higher strength ratio.

This, no doubt, accounts to some extent for the low strength shown by some of the sands regardless of the organic matter.

By reference to the color plate previously mentioned, it will be seen that when sand solutions show colors equal to or darker than Plate 3, they are not recommended for use in concrete. Since this is the practical dividing line between supposedly good and bad sands, let us consider it as giving us two grades, light colors, satisfactory, and dark colors, doubtful.

Considering first, then, Table I, it will be seen that 83 (52 per cent) of the sands show satisfactory color and the other 77 (48 per cent) are subject to doubt but it will be further noted that of the 83 "good"

TABLE II—SANDS OF DOUBTFUL QUALITY AMONG THOSE TESTED

Color	Above 100% No.	%	Under 100% No.	%
Plate I	7	21	1	33
Plate II	11	26	4	80
Plate III	7	23	8	73
Plate IV	3	25	5	45
Plate V	2	18	0	0
	31	24	18	56

sands, eight are low in strength, and of the 77 "doubtful" sands 53 (or 69 per cent) really are satisfactory. In other words, it is much more likely that a satisfactory sand will be rejected by this test than that an unsuitable sand will be recommended. In this respect the test is a fairly safe one.

The full effect of organic matter is not always reached within 7 days, however, as is sometimes brought out by the appearance of a reduction in strength ratio from 7 to 28 days. The reduction or increase in strength ratio from 7 to 28 days of sands exhibiting different colors is shown in Table III.

The percentage of samples showing increased strength ratios beyond the range of probable error in testing is practically negligible and so those in which considerable decrease occur only need be considered. From Table III it appears that more of the sands decreased in strength ratio than remained constant, thus showing that a certain amount of consideration for the possible reduction in strength ratio at 28 days should be given.

If, then, we have a well-graded sand and make a

TABLE III—APPARENT EFFECT OF ORGANIC MATTER ON STRENGTH RATIO FROM 7 TO 28 DAYS

Color	Strength Ratio— Decrease	Constant	Total
Plate I	13	23	36
Plate II	28	19	47
Plate III	23	18	41
Plate IV	13	10	23
Plate V	10	3	13
	87	73	160

color test for organic matter upon it and find that the color is similar to Plate 1 or 2, the chances of the strength ratio decreasing are about equal to that of its remaining constant, while if it is darker than Plate 3, the probability of a lower strength ratio at 28 days is about three to two.

Occasionally, one will find mineral salts in sands which act either detrimentally or as an accelerator and these substances will not show up with the caustic soda solution. This, of course, causes the test to fail completely in its ultimate purpose and reliance must be made upon other physical tests. For this reason if no other, it should be said that overconfidence in the colorimetric test must be avoided.

An important point not to be overlooked, however, is the peculiarities of the district from which a sand comes. Large areas are sometimes supplied with materials which, if use depended upon the indications of organic matter, would never build concrete roads. As has been pointed out, there are many sands of good quality showing a dark colorimetric test. On the other hand, there are regions in which a testing engineer can safely prophesy the tensile strength ratio by reference to mechanical analysis and color. Still others never find organic matter in their sand even though they experience the usual difficulties with the strength. Thus, the dependability of the test is best judged by those who use it according to the circumstances involved.

The greatest value of this test is felt by the prospector who is searching in new territory or examining unfamiliar materials. Then with the aid of a few observations about the source of supply, such as whether it is a pit or a river material, amount and character of overburden or location of stream and character of pollution, this information with the organic matter test as a check would form a sound basis for preliminary reports, provided the size and quality of the sand grains appeared satisfactory.

Excellent use may also be made of this test in the control of materials on the job or at the source of supply. If the organic matter test means anything whatsoever in the particular instance, it could be made to check up such details of production as stripping and washing. A darkening in color would indicate that organic matter was increasing and that materials and operations should be investigated.

In general, it can be said that the colorimetric test for organic impurities as made at present on concrete sands gives only an indication of where trouble might be expected and, as intimated above, should not be used as a positive factor in judging sands except in those localities where experience has shown it to be of undoubted reliability.

Study Inundation Method of Measuring Sand

Reports from the Bureau of Standards state that it has started an investigation to determine the feasibility of measuring sand for concrete in an inundated condition. This is in continuation of the studies made by R. L. Bertin, reported in *Engineering News-Record*, June 22, 1922, p. 1047. The Bureau of Standards notice on the subject reads as follows: "With small additions of moisture to sand, the sand swells, that is, the volume occupied by a given quantity of sand increases, and this increase sometimes reaches an amount as large as 38 per cent of the original volume. Conversely, the quantity of sand in a measure of given size varies greatly with the amount of moisture in the sand. This fact makes it difficult to insure the same proportion between sand and cement in successive batches of concrete because the percentage of moisture in sand varies greatly from time to time. Preliminary investigations have indicated that if the vessel in which the sand is measured contains sufficient water to submerge the sand, the same quantity of sand can be placed in the vessel regardless of the quantity of moisture originally obtained. The investigation is to determine whether the measurement of sand inundated will effect uniformity in the proportioning of sand to cement and consequently uniformity in the strength of the concrete. An affirmative answer to this question would mean the solution of one of the most troublesome problems in the concrete industry."

Greenheart as Teredo Resistant on Panama Locks

Experience Indicates that Shipworm Will Thrive in Timber Generally Held to Be Highly Resistant to Its Attack

By C. J. Embree
Office Engineer, the Panama Canal, Balboa Heights, C. Z.

EXPERIENCE on the structures of the Panama Canal has not borne out the estimate of the value of greenheart as a teredo-resistant contained in the following definitions:

"Greenheart—A valuable timber tree * * * remarkable for being almost exempt from the attack of white ants on land and of the teredo in water. * * * *"

New International Encyclopaedia

FIG. 1. END OF MIRAFLORES REGULATING VALVE
End view of valve shown in Fig. 2. This valve was installed in the brackish water of Miraflores Lake, 54 ft. above sea-level.

"Greenheart—One of the most valuable timbers * * * and its value is greatly enhanced by the fact that it is proof against the ravages of many marine borers which rapidly destroy piles and other submarine structures * * * *"

Encyclopaedia Britannica

When the Panama Canal lock structures were being designed it became necessary for the engineers to select some kind of timber that would be practically proof against the attack of marine borers such as the teredo. Naturally they turned to some of the better known woods used in lock-gate and ship construction, among them being teak wood and greenheart, which are rated by Lloyd's, first and second respectively. Before determining the kind of wood to be used, an investigation was made referring to as many authorities as possible. Among these were: "Greenheart Timber," by P. M. Moir, *Van Nostrand's Magazine*, Vol. 1, 1869; "Timber in Marine Works," by C. Graham Smith, *Engineering News*, April 5, 1879; "Timber and Timber Trees," Thomas Laslett, 1894; "Construction Woods of British Guiana," by L. M. Hill, *Proceedings Inst. C. E.*, Vol. 147; R. Hammersley-Heenan, *Proceedings Inst. C. E.*, 1897; "Greenheart de Demerara," published by Nouthandel vorheen G. Alberts Lzn & Co., Middleburg, Holland, 1904; G. Lacy-Good, *Proc. Cape Soc. C. E.*, Vol. II, 1905; R. Devenish-Mears, *Proc. Cape Soc. C. E.*, Vol. II, 1905; "Timber," by J. R. Baterden, Van Nostrand & Co., N. Y., 1908; "Wood," by G. S. Boulger, Ed. Arnold, London, 1908; "Some Data on the Resistance of Demerara Greenheart," by Houthandel vorheen G. Alberts Lzn & Co., Middleburg, Holland, 1910; Lieut. Col. Bailey; *Trans. Royal Scottish Arboriculture Soc.*, Vol. XXIII, Part II, 1910; "Greenheart," trade pamphlet published by Sprostons, Ltd., Georgetown, Demerara, 1912; also correspondence with various American consuls, foreign engineers, and handlers of timber in Demerara.

As a result of the investigation made at that time, the following facts were determined regarding greenheart. The specific gravity of the wood varies from 1.08 to 1.23, equivalent to 67.5 to 75 lb. per cubic foot. The heaviness of the wood seems to increase as the predominant hue deepens. It is also considered that the quality of the wood varies directly as the predominant hue of the timber, that is, the darker the wood, the higher the quality. The sapwood is not resistant to marine wood borers and should be removed when possible from timber exposed to their attacks. The shipworm and crustacean borers undoubtedly attack greenheart, but in the Netherlands, for instance, the attack does not proceed deeper than ¾ in., and ordinarily less. The wood is supposed to posses a poisonous character, rendering care necessary in working it; and this quality seems to be the basis for the belief that the heartwood softens the calcareous lining of the teredo's burrow, destroying the mollusk.

Reports on the use of greenheart timber in the tropics seemed to indicate that it would have considerable life. Some of these were as follows:

In Trinidad, W. I.: 15 years against the teredo. (American Consul, Trinidad, 1912.) At Georgetown, Demerara: 20 to 25 years against the shipworm. (American Consul, Georgetown, 1912.) At Bombay, India: Gates of Prince's Dock opened January, 1881, removed and replaced once. Steel gates now installed. At Calcutta, India: Kidderpore Docks; timber jetty approaches driven in 1890. After ten years many timbers reduced from a diameter of 14 in. to a diameter of 8 in. (*Proceedings Cape Soc. C. E.*, Vol. II, 1905.) South America: Firms handling greenheart admit that it together with all timbers is destroyed by marine borers.

As a result of the investigation outlined above, it was believed that greenheart would be the best timber that we could use. The locks and gates are fed by

fresh water in Gatun Lake, the lock structures being about seven miles inland from the ocean. In 1915 it was decided to install some regulating valves, and greenheart timber was used, as the valves would be subjected only to a velocity head of water and no trouble had been noted with the greenheart sill timbers. The valves were installed in May, 1917.

FIG. 2. FRONT OF MIRAFLORES REGULATING VALVE

These valves and those at Pedro Miguel Locks were practically destroyed by teredo although made of greenheart and submerged in water 54 ft. and 85 ft. above sea-level.

In 1918 and 1919 it was noted that the sill timbers were being pitted but it was not thought that this would prove serious. Later, in 1920, 20 per cent of the sill timbers were taken out at Miraflores Locks, as it was found that they had been attacked by teredo. Samples of the teredo were taken to James Zetek, entomologist for Ancon Hospital, for identification, and they were advised that they were probably of the species Xylotrya, but that he wanted to forward them to Washington to have them examined. Dr. Paul Bartsch, curator of marine invertebrates, U. S. National Museum, declared them to be a new species which he called "Bankia (Neobankia) zeteki," a scientific description of which will be found in the *Proceedings of the Biological Society of Washington*, March 31, 1921, p. 2[illegible].

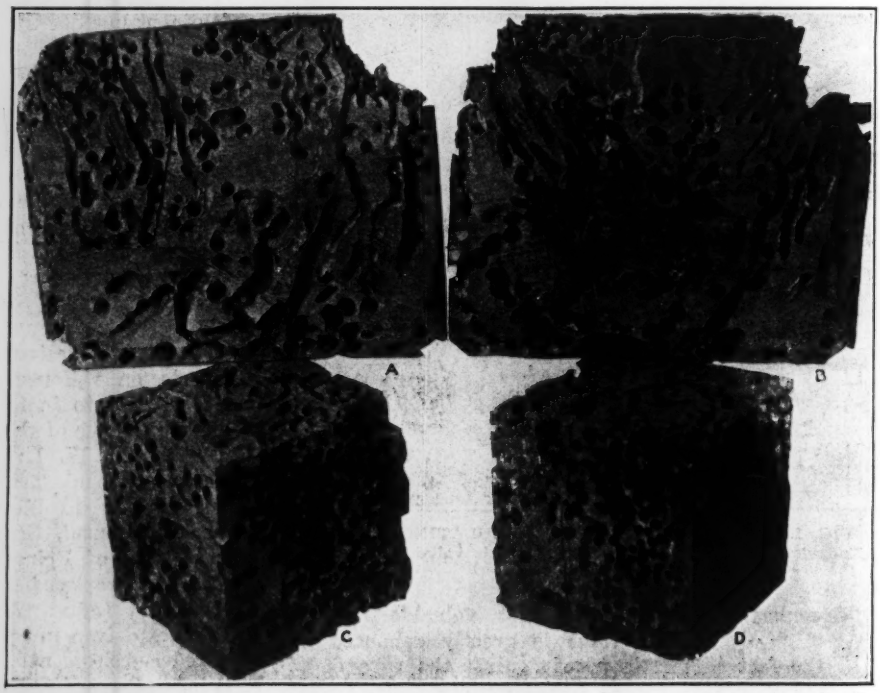


FIG. 3. SECTIONS OF GREENHEART HONEY-COMBED BY TEREDO

Pieces A and B are sections of Miraflores lock-gate timbers installed in January, 1914, and removed in March, 1922. Pieces C and D are parts of greenheart regulating valves shown in Figs. 1 and 2.

During the past year about 41 per cent of the sill timbers were removed at Miraflores Locks and replaced with a native timber known as Almendra, which has the physical characteristics of greenheart (strength) but which we know will be attacked by marine borers. This timber has been used because it can be obtained locally and we hope that it will have at least the life of greenheart, whereas it is far less expensive.

Fig. 1 shows one end of a regulating valve removed from the upper end of Miraflores Locks in April, 1922. Fig. 2 shows the front of the same valve, on which it will be noted that the attack of the teredo is considerably advanced on the lower timbers, and that there are surface indications that the shipworm has practically destroyed the valve proper. This was proved to be a fact when some of the timbers of the valve were broken up. Fig. 3, pieces *C* and *D*, are are also part of the regulating valves. These illustra-

tions indicate plainly that the worm has destroyed the valves. It is also known that the regulating valves at the upper and lower ends of Pedro Miguel Locks will have to be removed and replaced with steel valves.

In Fig. 3, pieces *A* and *B* show sections of one of the lock gate sill timbers originally installed in January, 1914, and removed in March, 1922. The timber shown was part of the intermediate gate sill in the west chamber of the upper lock at Miraflores. It is known that similar replacement must be made at Pedro Miguel Locks when maintenance work starts there next fall. Pedro Miguel Locks are used between Gatun Lake level (85 ft. above sea level) and Miraflores Lake (54 ft. above sea level).

Some action of the teredo has also been noted at the Atlantic locks, but not to such an extent that is has required the removal and replacement of the greenheart sill timbers.

The result of our experience with teredo and greenheart at the Pacific locks indicates that the shipworm will live and thrive in greenheart timber in sea water, in the brackish water of Miraflores Lake, 54 ft. above sea level and even in timbers located in upper Pedro Miguel Locks where the water is supposedly fresh (85 ft. above sea level) and fed by Gatun Lake.

Strengthening Truss Bridge Over Tracks at Chicago

Corrosion of Old Bridge Carrying Heavy Traffic Necessitates Reinforcement in Advance of Building New Structure

TEMPORARY reinforcement of trusses in the Jackson Boulevard bridge over the tracks approaching the Chicago union station has been carried out recently on account of extensive deterioration of the bridge and pending its reconstruction within the next few years.

This structure consists of a 64-ft. half-through plate girder span and a 213½-ft. pin-connected through truss span, both built in 1888. The structure is so located that smoke and gases from locomotives standing in the station caused extensive corrosion in members of the truss span. There are two 21-ft. roadways with an intermediate truss and two 8-ft. sidewalks outside of the outer trusses. In addition to very heavy automobile traffic, there is a large number of heavy mail trucks going to and from the Union Station. Since this street is a city boulevard it is not used by heavy commercial trucks, but for a large part of the day the structure is loaded from end to end with two rows of pleasure vehicles on each roadway and when the river span is open for passage of a vessel these vehicles stand as close together as possible on the approach span.

An inspection of the bridge, during which the minimum reduced section of each member was calipered, showed reductions in section of from 30 to 60 per cent, so that when calculations were made excessive stresses were found to exist in chords and diagonals. The live-load used in these calculations was 100 lb. per square foot on roadways and sidewalks.

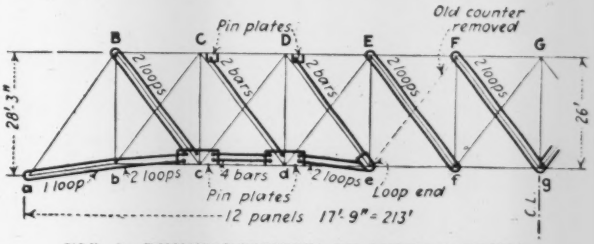


FIG. 2—REINFORCEMENT OF MIDDLE TRUSS

A new viaduct will be built at this point in connection with the new Union Station work and probably will be completed within the next two or three years. The north half of the existing structure will be removed when the new viaduct is started and the entire traffic of Jackson Boulevard will be carried by the south roadway until the first section of the new bridge is completed, and in service. Somewhat more extensive repairs were made, therefore, to the south roadway on account of the additional traffic which will be carried during construction of the new bridge. But on account of the short remaining life of the present structure only those members having a calculated stress which greatly exceeded safe working values were reinforced. For the same reason pairs of 4 x 18-in. timbers were bolted to the steel floor stringers for strengthening them, as a substitute for the more expensive method of renewing with steel members.

FIG. 1—BOTTOM CHORD AND WEB REINFORCEMENT IN MIDDLE TRUSS
The original eyebar chord is under the floor.

Part of the bottom-chord reinforcement is shown in Fig. 1, this work being above the floor while the original bottom chord, composed of eyebars, is below the floor. The location and arrangement of reinforcing members in the middle truss is shown in Fig. 2 and details of typical examples are given in Fig. 3. In the middle truss (Fig. 2) the work is as listed below, and this is duplicated at the other end of the truss.

Chord Reinforcement

a—*b*, One loop, 2¼-in. bars, both ends looped.

b—*c*, Two loops with 1⅞-in. bars; loop at *b* and pin ends in plates at *c*.

c—*d*, Four bars 1⅞-in. with pin ends in plates.

d—*e*, Two loops, with 1⅞-in. bars; pin ends at *d* and loop at *e*. Web reinforcement.
B—*c*, Two loops with 1⅜-in. bars; loop at *B* and pin ends at *c*.
C—*d*, Two 2-in. bars with pin ends.
D—*e*, Two 2-in. bars with pin ends at *D* and loops at *e*.
E—*f*, Two loops of 1½-in. bars.
F—*g*, Two loops of 1⅞-in. bars.

Truss reinforcement consisted of loop rods wherever space was available for placing these loops on the truss pins, the bars and loops being connected and adjusted by turnbuckles. In two panels of the middle truss the old counters were removed to provide room for placing the new loops on the pins. At some panel points an alternative method was made necessary by the position of the chord eyebars. This method consisted of riveting pin plates to the truss posts for the connection of flat yokes carrying the new chord bars. At some of the top-chord panel points also it was necessary to rivet pin plates to the chords for the attachment of yoke ends on the diagonal bars. These various connections are shown in Figs. 2 and 3.

Jacking Posts—In addition to the reinforcement of the trusses it was found necessary to renew the timber bents supporting the east end of the south truss, owing to the crushing of the caps under load. This timbering was placed under the span in 1917 to form an extension of the masonry pier when the bridge was shifted southward about 5 ft. to line up with the new bascule span built across the river at that time.

Restricted space under the bridge made it impossible to place jacking bents at panel points and the method adopted was to raise the trusses by means of steel jacking posts connected to the end posts, as shown in Fig. 4. It will be noted that bar loops were used to connect the jacking point with the pin at the first panel point of the bottom chord in order to provide against bending the end post. Four 50-ton jacks were used under the post, the jacks being mounted on temporary timber bents placed close against the bridge pier. The calculated load of the middle truss was about 140 tons.

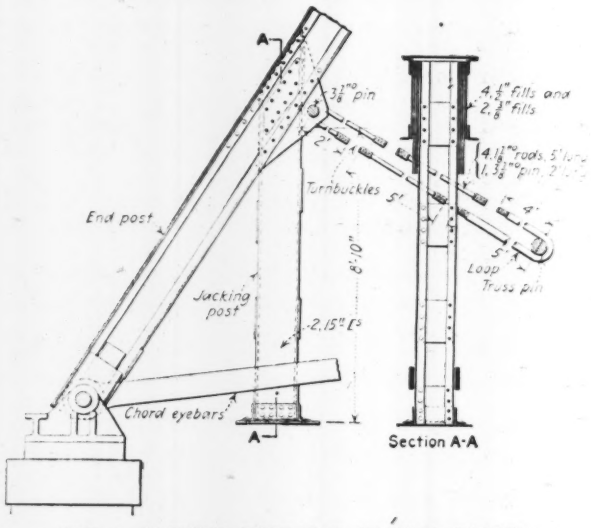


FIG. 4—JACKING POST FOR RAISING BRIDGE

This entire work was made necessary largely through postponement of the Union Station work during the war, and from its temporary character it was more or less of a makeshift, only such repairs being undertaken as were considered absolutely necessary for the safety of the structure until its renewal. The truss and floor-system reinforcing was designed by J. C. Bland.

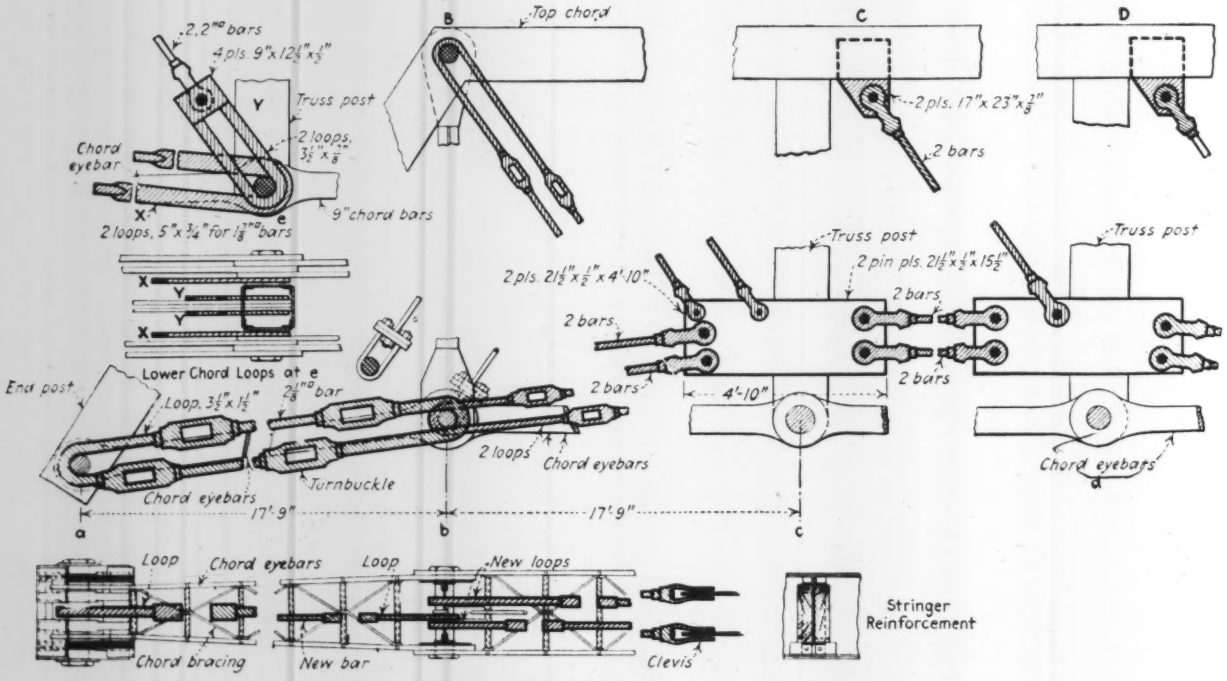


FIG. 3—DETAILS OF REINFORCING MEMBERS OF BRIDGE TRUSS

engineer of bridges and buildings, Pennsylvania R.R., Pittsburgh, Pa. The work was done by the Ferro Construction Co., Chicago, under the supervision of C. L. Barnaby, division engineer, Pennsylvania R.R. Field inspection was done and the raising apparatus designed under the direction of T. J. Skillman, chief engineer of maintenance-of-way, Pennsylvania R.R. (northwestern region), Chicago.

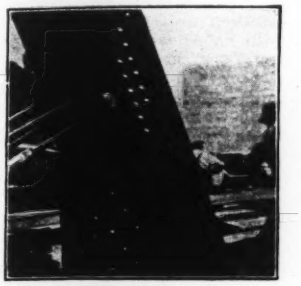


FIG. 5—JACKING POST CONNECTION TO END POST OF TRUSS

Somewhat similar reinforcement operations on two other Chicago bridges, one of which was a drawspan, were described in *Engineering News-Record* of May 8 and 15, 1919, pp. 913 and 956.

Transfer of Whole Town 11 Miles by Truck and Trailer

Jennings, Mich., Being Moved to Cadillac on Specially Built Structural Steel Frame of Trailer — Running Time Four Hours

HOUSES in the abandoned town of Jennings, Mich., are being transferred by truck and a specially built gigantic trailer to Cadillac, Mich., 11 miles distant. Jennings was founded about 25 years ago by the Mitchell Brothers Lumber Co. A sawmill, flooring and chemical plant gave employment to 500 men. Now the industries, families and residences are all being moved. Many plans for the transfer were considered and rejected as impractical. Finally engineers of the Acme Motor Truck Co. proposed building for the lumber company a trailer with four wheels abreast supporting a steel frame capable of carrying a 35-ton house.

There are 75 to 100 houses to move, an operation which will require three or four months' time. They vary from 24 x 30 ft. to 24 x 40 ft., and are all 1½ stories high, well-built, comfortable and arranged for convenience; and many of them have hardwood floors. Their weight varies from 15 to 35 tons. The windows are left in all of them and none has been cracked, except in passing through the city of Cadillac, when the limbs of shade trees along the streets broke one or two when the first house was brought in.

The 11-mile trip is made in about 4 hours, which includes all necessary stops to wait for traffic to pass before entering upon a stretch of road too narrow to allow passing, though the actual running speed is from 5 to 8 miles per hour. Loading and unloading and passing through the city requires a longer time, however, as it is often necessary to raise or remove the electric light and telephone wires. Up to Sept. 1 the rate of moving was about two houses every three days, although as the crew doing the work grows more accustomed to it it is probable a house a day will be brought over the road. The flooring and chemical plant will also be brought to Cadillac, which will result in an increase of from 500 to 1,000 in population and make additional homes necessary; at present a shortage of houses exists in the city.

The frame of the trailer is 24 ft. wide by 42 ft. long and consists of five longitudinal members of structural steel, securely held in place by two main and four supplementary transverse beams. Diagonal cross-braces are built into the frame to distribute the stresses where excessive weaving and twisting would occur. To give added rigidity and strength to the structure, the three center longitudinal members are reinforced with large

STORY-AND-A-HALF HOUSE READY FOR 11-MILE JOURNEY

trussrods securely anchored to the member at each end and supported at equal intervals by cast-iron struts. The tension in these rods is equalized by a series of turnbuckles.

The platform at the forward end of the frame is raised 18 in. above the trailer and is constructed of channels, I-beams and plates, substantially braced with diagonal members to the forward transverse member of the trailer proper in order to eliminate side sway. This platform is connected to the trailer frame by means of heavy gusset plates and channels of sufficient strength to transfer safely approximately 25 per cent of the weight of the trailer and load to the rocking fifth-wheel mounted on the truck.

At the rear the trailer is carried on four cast-steel truck wheels, all abreast, equipped with 40 x 6 dual truck tires. The wheels are arranged in pairs, each wheel operating on tapered roller bearings supported by a tubular steel axle shaft. The shafts of each pair of wheels are bolted together at the center through a large steel casting which is supported by an extra heavy wrought-iron pipe extending through it and at right angles to the shaft. Heavy steel pillow blocks at either

STRUCTURAL STEEL TRAILER FRAME FOR TRANSPORTING HOUSES

end of this pipe support the weight of the trailer and load through coil springs attached to the trailer frame. This unique construction not only cushions the load but successfully provides for road inequalities, an essential result when taking into consideration that the distance between the outside wheels is 11 ft. To relieve the springs from driving stresses a radius rod with flexible connections is provided for both sets of wheels, the forward end of which is secured rigidly to the trailer frame and the rear end fastened to the end of the wrought-iron pipe through a swivel connection. In order to maintain perfect alignment of all four wheels, the wrought-iron pipes supporting the axle shafts are tied together by a system of flat bars secured to the trailer frame and so arranged as to compensate for spring deflection.

In loading the house is raised by a series of jacks located at each side. The two outside longitudinal members of the trailer, which are bolted on, are removed, the trailer is then backed under the building and the house is lowered until it rests evenly on the trailer frame. The side members are replaced if it is found necessary and the unit is ready for its journey.

One Man in Thousand Is Oregon Engineer Ratio

THIS year the holders of licenses to practice engineering in the state of Oregon number about one for every thousand of the state's total population. The Oregon license law was passed July 1, 1919, to go into effect Jan. 1, 1920. Reference to the act appeared in *Engineering News-Record*, Sept. 25, 1919, p. 631. Within the time limit prescribed for the granting of licenses without examination about 1,150 applications had been received. Only about seventy-five applicants have been examined since that time and many of these are engineers from other states wishing to practice in Oregon.

While some 1,200 engineers is considered a relatively large number for a state of only 783,000 total population (1920 census), only about 800 engineers are now operating, as shown by the number of licenses taken out this year. Under the Oregon law, once an engineer has qualified and received a license he does not forfeit that license by non-payment of the annual fee and even if no annual fees are paid for a number of years he is entitled to practice again whenever he pays up the accumulated fees, plus a slight additional tax imposed as a penalty for delay.

The first licenses issued were obtained in a comparatively easy way under the terms of the law, but the policy of the board of examiners is now to maintain a strict standard of high professional qualifications. As a result only about two-thirds of the candidates that apply for examination are now being rated with a passing grade. Applications are being received at the rate of two to four per month.

Handling Customers Water Bills in Toledo

The 45,000 water customers accounts in Toledo, O., cost in 1921 slightly less than $2 each. This is too much for bookkeeping, billing and collecting, according to the latest annual report of the water department, and steps are being taken to reduce it. Accounting, meter reading and administration cost $9.28 p. m. g. as against $8.52 in 1920.

LETTERS TO THE EDITOR

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Drainage Wells That Might Pollute Water Controlled in Florida

Sir—In *Engineering News-Record*, of July 13, p. 75, I note an article by R. M. Downie, Keystone Driller Co., Beaver Falls, Pa. As this article opens with a reference to Florida, and may be misleading to people interested in that state, I wish to call attention to the fact that the sinking of such wells is a violation of state laws [except where approval for the wells is secured from the State Board of Health—EDITOR]. An act was passed by the Florida Legislature (approved June 7, 1913) entitled: "An Act to Preserve the Purity of the Underground Waters of the State of Florida for the Protection of the Public Health." This act specifically states that:

"No municipal corporation, private corporation, person or persons, within the state, shall, after the passing of this Act, use any cavity, sink, driven or drilled well now in existence, or sink any new well within the corporate limits, or within five miles of the corporate limits, of any incorporated city or town, or within any unincorporated city, town or village or within five miles thereof, for the purpose of draining any surface water or discharging any sewerage [sewage] into the underground waters of the state, without first obtaining a written permit from the State Board of Health." The act further states that the State Board of Health may "revoke such permit at any time on due notice after investigation and hearing."

The object of this act of the Legislature is to prevent the fouling of the very excellent underground waters of the State, as turning the surface drainage into the same underground sources from which the water supply of many of the cities, villages and towns of the State of Florida receive their supply, is a very dangerous expedient.

The last sentence of the next to the last paragraph of Mr. Downie's article reads: "The outlet from the wells is always some hundreds of feet below sea level and the sewage does not at all contaminate the underground waters." The outlet from these wells is an uncertain matter as the head on most of them is from 12 to 17 ft. above sea level on the west coast and if a well is left open it will flow at sea level, so that the water that is put in at one place may flow out at another.

CHESTER D. MCFARLAND,
General Manager, Tampa Water Works Co.

Tampa, Fla., Sept. 11.

Color and Harmless Bacteria in Water Supplies

Sir—The articles by C. M. Saville and A. L. Gammage in *Engineering News-Record*, Sept. 7, pp. 380 and 391, and the discussions at the New England Water Works convention on Sept. 15 by J. E. Garratt on the effect of copper sulphate on the length of filter runs at Hartford and by Robert Spurr Weston on hydrogen-ions have led the writer to set down here some radical thoughts on water purification that have persisted with him for two or three years. These suggestions are made not with the idea that even the writer himself has reached unalterable conclusions, but rather in the hope that someone with more opportunity for experimentation may be sufficiently interested to pursue the matter in a practical way.

The exceedingly interesting studies of hydrogen-ion concentration that have been made in recent years have indicated the value of that study in the solution of several troublesome problems connected with water purification, but it is not clear that their greatest value has yet been appreciated. It is my opinion that the most important

possibilities of these hydrogen-ion studies will be found to lie in the direction of preventive measures rather than the curative ones so far considered. For example, it has long been my belief that the installation and operation of expensive filter plants for no more important reason than the removal of color and organisms—both perfectly harmless—is an unscientific and unjustifiable expense, and that if we water-supply engineers, combining forces with our friends the chemists and the physicists, could but perform a sufficiently thorough research to determine the fundamental nature of color in water and why some streams are highly colored while others flowing from apparently similar watersheds are not, we would perhaps discover that the installation of small automatic dosing machines on the principal influent streams of a reservoir would eliminate the color problem and possibly also that of organisms. The value of the hydrogen-ion studies, it seems to me, is in solving the question of what materials to put into such dosing machines for the purpose of neutralizing color.

As a practical illustration of this kind of a problem, it would be interesting to know the relation between the hydrogen-ion concentration of the water of Esopus Creek as it enters and as it leaves Ashokan Reservoir—particularly at times of high runoff. It has been pointed out to me that there is often a quite distinct line of demarcation in the reservoir between the slightly milky turbidity of the entering water, carrying as it does colloidal clay, and the practically colorless water of the main body of the reservoir. I cannot help wondering if there is not a change in the hydrogen-ion concentration at that line of demarcation and whether the clay content of the influent water is at that point neutralized by some more dominant characteristic of the main body of accumulated water. The color of the water in the East Basin of the Ashokan Reservoir is low while the color of the stream that in pre-reservoir days flowed out of the unstripped swamp that formed most of its bottom rivaled the "dark" brand of liquid that once made Milwaukee famous. Is one not justified, then, in hazarding the guess that colloidal clay neutralizes the color and that something connected with the color neutralizes the clay and thus both the turbidity and the color are eliminated? If this can be accomplished by natural means does it require too great a stretch of the imagination to suggest that scientific methods could be devised to eliminate by relatively simple means either color or turbidity? Further, would not the cost of such a scientific study be insignificant in comparison with the cost of even a single modern purification plant?

Coming home from the New England Water Works convention the other day a number of engineers were discussing the crude but customary method of applying copper sulphate to a reservoir water by dragging bags from a boat as compared with the more scientific application of definite quantities per million gallons in the Catskill Aqueduct between Ashokan and Kensico Reservoirs, and it was suggested that probably the main reason for this crude method was the fact that the first man who applied copper sulphate did it in that way. Whether or not the growth of organisms can be controlled by continuously dosing the influent streams of a reservoir with copper sulphate or some other substance (and it may well prove inadvisable, even if possible, to entirely prevent their growth) it is evident that one reason why corrective measures have mainly been followed in the later refinements of water purification rather than preventive measures is plain inertia—the fact that the discovery and development of the principle of slow sand filtration was such a notable achievement that unconsciously we have felt that future progress in water purification must be made from that as a starting point, whereas it seems quite evident to me, in spite of the contrary opinions of some of our most eminent sanitary engineers, that the time is not far distant when, sterilization having been standardized, the filtration of a bacterially clean surface water supply will be a thing of the past.

FRANCIS B. MARSH,
Designing Engineer, Providence Water Supply Board

Providence, R. I., Sept. 16.

Model Tests of Skew Arch Thrust Questioned

Sir—In your issue of April 20, p. 638, Prof. Clyde T. Morris reports the results of experiments upon a model of a skew arch of reinforced concrete. His method was to subject the model to a uniformiy distributed load, permitting one end (supported on springs) to yield under the load, and then by means of jacks to bring the movable end back to its original position. Under these conditions he found that the resultant horizontal thrust was very near the obtuse corner of the arch.

The generally accepted theory of arch analysis is premised on fixed abutments. The model with which Prof. Morris experimented did not have fixed ends and its action was in effect that of a spring.

Consider a steel spring in the form of a skew arch standing on a smooth level surface and subjected to a symmetrically distributed load. The spring would begin to bend about an axis perpendicular to the face of the "arch," which would lift the acute corners off the supporting plane and leave only the obtuse corners bearing. Further bending would be about an axis perpendicular to a vertical plane through the obtuse corners, and the obtuse corners would slide in the direction of a line joining those corners. To bring the spring ends back to their original position (within the limits of observation), it is only necessary to apply equal and opposite horizontal forces at *any* symmetrically located points of the spring ends so that both of the applied forces are in a vertical plane which passes through the center of the crown. To restore the spring ends to *exactly* the same position as before distortion, with unit stresses at each point identical with those which would have developed had the spring ends been fixed originally, would require a definite distribution of forces; but to determine that distribution experimentally supposes an accuracy of measurement not easily attained.

Prof. Morris applied replacing forces so that the horizontal resultant acted near the obtuse corner, with components of about 910 lb. normal to the abutment and 220 lb. end thrust for the maximum load. It is believed that a horizontal resultant of 1,700 lb. applied at the acute corner —910 lb. normal to the abutment and 1,440 lb. end thrust— would serve equally well as a replacing force.

The burden of proof is upon Prof. Morris to show that conclusions based upon his experiment are applicable to skew arch bridges.

W. H. YATES,
Consulting Engineer.

New York, Aug. 28.

The Mission of the University

Sir—Permit me to express to you my unqualified approval of your editorial on "The Mission of the University" in the number of Aug. 31.

The expressed intention of the scheme of instruction which our universities have so far proposed for their engineering students is to develop, so far as they are able, trained technicians. Now a man who is a trained technician may not be in any meaning, except a very limited one, an educated man. A skillful carpenter or an expert mechanic are specialized technicians in perhaps as accurate a sense as the numerous common or garden varieties of graduates our schools are so busily occupied in turning out. It may even be that the mechanic would be equally trained with those select few who on the day of their graduation could elucidate the theory of least squares or develop the analysis by which, on the elastic theory, the stresses in monolithic arches are computed.

It is only one of the duties of the university to impart specialized instruction; it is indeed only one of its duties to develop the power or increase the capacity of its students to think in a logical and orderly fashion. The capacity to reason acutely and to analyze accurately is for any man a most important intellectual attribute, and it may be that our schools, while they cannot create, are doing all that can reasonably be expected of them to develop and expand this quality. But the true essence of education is another matter. For a man to be educated he must at least have touched

something of what is fine, enduring, distinctive—of what is set apart from all that is practical, severe and concrete. He must have felt the glow of higher enthusiasms, of perhaps impractical idealisms. He must be able to set up for himself some standard of comparison, some scale of relative values, even though crude and ill defined, by which he can judge present performances and assay their worth. Only in this way, by an insistence on what appears to the common view impractical, unrelated to the conditions to be encountered, is it possible to develop a finer vision, a profounder conception of the dignity and worth of what we are attempting to execute, and an imagination more creative; because the ideals conceived and the goals attempted are not discreet and particular.

The universities are the only agencies through which to accomplish this. There is no question that they are attempting to fulfill with all their power the obligation of pounding facts into resistant brains; but are they fully aware—and particularly are our engineering schools aware—of their higher and their more insistent duty to evoke, if not reasoned ideals, at least a conception of things beyond that which is practical and opportunistic; to instill, if not culture, at least a regard for culture; to turn out men that are human and sympathetic with the finer touch that comes from more highly developed sensibilities?

Until engineers realize that the most important half of their education lies entirely outside of technical training they will not succeed, they will not even be called upon as leaders in a new world—or in an old world, if you like. And it is entirely right that this should be the case.

THOMAS THOMSON TOWLES,
Richmond, Va., Sept. 11, Member, Am. Soc. C. E.

Suggests Foreign Woods to Resist Borers

Sir—In view of the inquiry into protective measures against the teredo now being conducted by the National Research Council and the Engineering Foundation, I write to recommend experimental work with certain foreign timbers that are able to withstand the action of marine borers and that are available to South America and Australia.

Holland is making extensive use of greenheart. I remember that the specifications for the fishing harbor of Scheveningen called for greenheart timber, which is still standing intact after 18 years of exposure to shipworm. This greenheart is one of the most valuable timbers and is the product of the *Nectandra Rodioei*, averaging 70 ft. in height. It is a native of Guiana, South America, and exists inland in great abundance. The Indian name of the tree is "bibiru." Greenheart wood is of a dark green color and is one of the most durable of all timbers. Its value is greatly enhanced by the fact that it is proof against the ravages of marine borer.

In Kelvingrove Museum, Glasgow, there are two pieces of planking from a wreck submerged during 18 years on the west coast of Scotland. The one specimen, greenheart, is merely slightly pitted on the surface, the interior of the wood being perfectly sound and untouched, while the other specimen, djati or teak, which comes from the East Indies, is almost entirely eaten away. Greenheart, under either transverse or tensile stress is one of the strongest of all woods. It is exceedingly dense and its specific gravity is very high, being about 1.15. A timber equally used in European waters is jarrah, or *Eucalyptus marginata*, native of S. W. Australia, a close-grained, heavy red wood, often called "ironwood" in Holland. This timber is not attacked by teredo termites, or other destructive organisms, because, perhaps, of its alkaloid carrying property and its great hardness. It very much resembles mahogany.

This jarrah tree grows straight in the stem to great size and yields squared timber up to 24 in. in diameter and 40 ft. long. It has a specific gravity of 1.01. In tropical countries it resists also the ravages of white ants. When filled with the sap at its lowest point and well seasoned, this wood stands exposure in the air, earth, or sea remarkably well, on which account it is in demand for railw sleepers, telegraph poles and piling in British colonies a in the East Indies.

The wood, however, frequently shows longitudin blisters, or lacunae filled with resin, as may be observed spurce fir timbers. One disadvantage is that it is deficie of fibre, breaking with a short fracture under compar tively moderate stress. Trautwine quotes lignum-vitae, similar wood, with a specific gravity of 1.33 weighing lb. per cubic foot. Both greenheart and jarrah timber ha been classed at Lloyds' Register for ship building pu poses in Table A, lines 1 and 3 respectively.

The greenheart and jarrah woods in particular shoul be studied. If, however, these timbers are known t engineers in this country, I should like to be excused fo this letter, but not having found a single mention of thes valuable woods, I simply could not refrain from speakin of them. But why is it that jarrah and greenheart hav not been mentioned? If these timbers are known to the National Research Council and the Engineering Founda tion, why have they decided to launch a nation-wide campaign against these insects while foreign timber can stand the test? These timbers give splendid service in European waters—why not here? C. KOOY.

New York, May 36.

[As indicated by the article on p. 619 of this issue, experience at Panama does not seem to bear out Mr. Kooy's confidence in greenheart at least, as a solution of the marine-borer problem.—EDITOR.]

Progressive Construction of Highways—A Question of Origin

Sir—The editorial, "Maintenance the First Task of Highway Development," appearing in *Engineering News-Record*, Aug. 17, p. 259, is very pleasant reading to me. The part printed in italics appears to have been taken, almost verbatim, from an article on highways printed in your issue of March 21, 1918, and the whole editorial shows that the article mentioned has had and is having an educational value—although the author gets no credit for the complete change in trend of thought of highway engineers.

I am as firmly convinced as ever that if the progressive method of highway construction were adopted and carried out to its logical conclusion, we would increase our effective highway system by 100 per cent with the same capital investment. Would it not please the people to have twice the improved highway mileage at the same cost? What a boon this progressive method would be to the harassed highway departments in this time of shortage of coal and materials of all sorts. The whole force, and a greatly increased force, could be put to work properly forming subgrades, building bridges and culverts, so that when "normalcy" returns thousands of miles of roadway would be ready for hard surfacing. A. A. YOUNG.

Jewett City, Conn.,
Aug. 19, 1922.

[Progressive construction as a policy of highway development is so natural a thought that one is easily misled into assuming priority in its expression. The writer of the editorial mentioned, certainly, and Mr. Young, probably, were late in the field with progressive construction as a novel idea. It was definitely laid down as a highway improvement policy in Iowa as early as 1913 and had begun to be formulated into practice nearly ten years previous. The account of this development will be found in *Engineering News-Record*, Nov. 27, 1919, p. 953, and Dec. 11, 1919, p. 1008. Incidentally the article contributed by Mr. Young in 1918 was unknown to the writer of these articles on Iowa practice and of the editorial in our issue of two weeks ago. Any verbal resemblance is a coincidence. The editorial writer drew his inspiration from a long knowledge of practice in Iowa and a later conviction of the value of the practice from observing results in North Carolina.—EDITOR]

NEWS OF THE WEEK

New York, October 12, 1922

Civil Engineers' Directors Favor Federation

Pass Resolution at San Francisco Expressing Sympathy With Movement

Staff Correspondence

The meeting of the board of directors of The American Society of Civil Engineers in San Francisco on Oct. 2 and 3 was representative of all parts of the country, 21 of the 28 directors being present. A step toward joining the Federation was taken by passing a resolution, "That this board is in sympathy with a movement to join the Federated American Engineering Societies when financial and other conditions permit." This resolution was carried by a vote of twelve to eight and it was agreed that the question of when the board deems it advisable to join should be discussed at the January meeting.

It was definitely decided to hold the spring meeting in New Orleans early in the spring but no exact date was set. The subject for that meeting will be ports, harbors and river control. An invitation from Richmond, Va., to hold the annual meeting next year in that city was received and this with an invitation from the Illinois section to hold the fall meeting next year in Chicago was held over for decision by the new board in January. The subject for the fall meeting will be railroad terminals. The next annual meeting must be somewhere in District Five, according to the decision at the Dayton meeting.

A special committee of the board was appointed to handle questions affecting local sections. T. L. Condron was placed on the official list of nominees for director of District Eight succeeding A. S. Baldwin, deceased.

The two-day fall meeting following the board meeting was very well attended, the total registration being about 600, of which about 150 were junior and senior students from University of California and Stanford. The subject of water power was well chosen for a Pacific Coast convention at this time, as was attested by the very general interest and response. Entertainment features and particularly the several excursions arranged by the local section were well attended and were made most enjoyable by favorable weather conditions.

Organize Ontario License Board

Organization for the registration of professional engineers under the act passed by the Ontario legislature has been completed and a permanent office opened in Toronto. Gen. C. H. Mitchell is president and Robert A. Bryce, vice-president of the provisional council and R. D. Wolsey registrar and secretary-treasurer. The council comprises representatives of each of the branches of the profession, namely, civil, mechanical, electrical, chemical and mining.

Buffalo Transit Company Sues City for Strike Damage

Alleging that the city of Buffalo failed to provide proper protection for its properties during the recent strike, the International Railway Co. of that city has filed a claim for damages amounting to $3,805,250. Of this amount, only $4,250 is for property damage. Loss in operating revenue is placed at $1,800,000 and loss of good will in the community at $2,000,000.

Motor Vehicle Weight Limit Restricted in Massachusetts

Seasonal limitations on gross weight of motor vehicles are provided for in an amendment, effective Sept. 12, to the motor vehicle law of Massachusetts which permits a maximum gross weight of 14 tons and 800 lb. per inch width of tire. The amendment grants to the State Department of Public Works authority to rule off the road at any season of the year vehicles having gross weights exceeding 10,000 lb., if in the opinion of the department they would cause serious injury to the highway.

Railway Bridge and Building Association to Meet

At the annual meeting of the Railway Bridge and Building Assn. to be held at the Gibson Hotel, Cincinnati, Oct. 17 to 19, the following subjects will be included: Pile driving records; labor-saving devices in routine bridge and building work; merits of wood, steel and iron tanks; building inspection and records; painting structural steel; framing bridge timbers; reconstruction of the Ohio bridge of the Cincinnati Southern Ry.; construction and maintenance of sewers and drains.

Kansas City to Build Huge War Memorial

Hool & Johnson, engineers of New York City, have been engaged as engineers on the design and construction of the Liberty Memorial at Kansas City, Mo. When completed this will be, it is believed, the greatest memorial structure in the world. It is to be built by public subscriptions after the design made by H. Van Buren Magonigle, architect, of New York City. Mr. Magonigle was awarded the prize some time ago in a competition. The structure comprises a huge base, in the center of which rises an eight-armed shaft, 55 ft. in diameter at the base and 287 ft. high. On either side are two large memorial halls. The main structure is to be of concrete with stone facing. It will be located on the height of land opposite the new Union Station. About $2,500,000 of the subscription has already been raised. The designs are now under way and it is hoped that the first contract will be let within a few months.

Municipal Field Surveyed at Cleveland Meeting

A.S.M.I. Gives Chief Attention to Streets and Sewage Problems—Horner Elected President

Staff Correspondence

The leading subjects discussed at the twenty-eighth annual convention of the American Society for Municipal Improvements at Cleveland last week related to streets, sidewalks, sewers and sewage treatment, but the whole municipal field was surveyed. As usual at these conventions the program was a heavy one, requiring much crowding and leaving scant room for discussion at some points; but could it have been foreseen that most of the numerous committee reports would produce little or no discussion jams might have been avoided. As it was, three sessions ended with much spare time while two or three others could have utilized more time, particularly the four-hour session devoted to sewage treatment.

In his presidential address Edward S. Rankin, engineer in charge of sewers, Newark, N. J., said it was desirable not to give the society, through its name, a limited engineering character, so as to continue to attract to the meetings, as has been done from the first, a considerable number of members of the city governing and executive boards.

Reports by the Executive Committee and the secretary showed that for the eleven months ended Sept. 1 there had been a net membership gain of 15, or from 648 to 663. The active members on Sept. 1 were about 500. A feature of the convention was the daily *A. S. M. I. News*, which gave the names of those in attendance, and made various timely announcements.

Amendments Adopted

Constitutional amendments were adopted providing (1) that the number of committees shall be determined by the Executive Committee, but that there shall be a Committee on Papers; and (2) that engineers employed by street railway and other utility companies occupying streets and highways shall be eligible for active instead of associate membership only.

The principal officers elected for the ensuing year were: President, W. W. Horner, St. Louis, Mo.; first vice-president, E. R. Dutton, Minneapolis, Minn.; secretary, C. C. Brown, St. Petersburg, Fla.; treasurer, Robert Hoffman, Cleveland, Ohio. Memphis, Tenn., was chosen as the next meeting place, after considering invitations from Washington, D. C., Louisville, Ky., and Atlanta —the latter having been withdrawn or postponed until 1924.

Two evening sessions were held jointly with the Ohio State Conference on City Planning. Monday evening was devoted largely to state park sys

tems, with special reference to needs and opportunities for such a system in Ohio. The feature of the other joint session was a lantern-slide talk by N. P. Lewis, New York City, on the regional plan for New York City and environs. (See *Engineering News-Record*, May 18, p. 842.) Mr. Lewis spoke also as chairman of the City Planning Committee of the A. S. M. I.

E. A. Fisher, Rochester, N. Y., as chairman of a Sub-Committee on Local Subdivisions, outlined the method of controlling subdivisions or new real-estate layouts in Rochester, which is under the jurisdiction of the City Planning Bureau. In a paper on control of heavy traffic at street intersections, Clarence Farrier, Chicago, proposed storage space or temporary parking of cars in areas set aside for the purpose rather than regulation on some circulating plan.

Paving, Sidewalks and Sewers

Altogether there were scheduled for the two Wednesday sessions seventeen committee reports and six papers on paving, sidewalks and sewers. Of the committee reports listed, thirteen were on specifications for the various kinds of pavements. Many of these twenty-three numbers resulted in brief progress reports only and a few brought no response. Nearly all of the reports on paving specifications presented had already been before the society in printed form and were either submitted for final action or else for revision.

For the Sub-committee on Paving, W. A. Howell, Newark, N. J., reported that owing to the high cost of granite blocks there is now a tendency to use less substantial substitutes, renewal of the latter in a few years being economically justified. Recent actions of granite quarrymen and pavers were characterized by Mr. Howell as ill advised. Clarence D. Pollock, New York City, read a paper designed to show the need of further study of tests for granite blocks. The toughness test, he thought, is not in accordance with conditions in service; the test known as that for the French coefficient for wear comes nearer, if attention is given to disintegration of the granite. One speaker questioned the need for these tests, which he said are relatively new here and not used abroad.

George H. Norton, Buffalo, N. Y., as chairman of the Sub-Committee on Street Maintenance, urged the members to study the section of his last year's report dealing with the economic life of pavements since the 1921 *Proceedings* came out too late for study before the 1922 meeting. Considerable discussion arose on backfilling trenches made for sewer, water and other house connections. The common practice of requiring that such connections be required before new pavements are put down was commended while the frequently accompanying rule that no such connections would be allowed for five years after a street is paved was severely criticised because of general non-enforcement. A better plan is to exact rather heavy guarantee funds against damage from settlement and to hold the money for a number of years, since settlement may come long after the trench is backfilled. Puddling on backfilling was deprecated.

The Committee on Sheet Asphalt Specifications, through E. A. Kingsley, chairman, Little Rock, Ark., submitted a number of changes designed to simplify and clarify existing specifications. Proposed specifications for fine aggregate bituminous concrete were submitted by Thomas E. Collins, Elizabeth, N. J., chairman of a corresponding committee. After having voted to send both these specifications to letter ballot, each was referred back to the committee at a later session on account of certain unmentioned discrepancies between the two. Other specifications sent to letter ballot, with changes from the draft printed in the 1921 *Proceedings*, deal with (1) broken-stone roads, (2 and 3) bituminous surface-treated macadam (separate specifications for hot and for cold application) and (4) gravel roads—all from a single committee of which D. B. Davis, Richmond, Va., is chairman. Still another set of specifications that will now go to ballot is the one on subgrades and foundations, F. A. Reimer, chairman, Newark, N. J. These were first presented in 1920, then re-submitted with modifications in 1921 and printed in the *Proceedings* for that year.

Non-Bituminous Paving

For the Special Committee on Standard Tests for Non-Bituminous Paving Materials, Prof. A. H. Blanchard, University of Michigan, recommended the adoption of some 15 tests that have been before the society for a year, and the consideration for later action of a number of standard tests, some with slight changes, for the Am. Soc. T. M. and the Am. Soc. C. E.

Although "full sets of sewer specifications" were submitted in 1921, stated C. L. Howell, chairman, Buffalo, N. Y., they will have to go over another year to give time to consider points brought out by a questionnaire and by conferences at the Cleveland convention.

Dr. A. R. Hatton, specialist in municipal government, gave recognition to the extent to which specialization in engineering, health and law have gone and advocated carrying specialization to embrace all administrative heads, including the chief executive. The complete adoption of the plan is not undemocratic, as some urge, since the democratic principle involves as a first step the election of policy-determining authorities and as a second and no less important step the selection of competent trained men to carry out the policies. In discussing Dr. Hatton's remarks N. P. Lewis, New York City, expressed the conviction that the engineer should contribute to the formulation of policies to a larger degree than Dr. Hatton had implied, but the latter laid stress upon the greater heed given to the opinion of professional men than to those of non-professional instancing the trained city manager as being given more credence than the mayor, though the latter has veto power.

Traffic and Transportation

A tentative report for written discussion up to July 1, 1923, with a view to final drafting for submission to the 1933 convention was submitted by the Committee on Traffic and Transportation, Prof. Blanchard, chairman. Among detailed proposals for motor truck weights and dimensions was a weight limit of 28 tons for truck and load. Prohibition of city licensing of motor vehicles is proposed with a provision for returning part of the state license fees to cities, to be used exclusively for streets. Franchises for companies or individuals operating motor vehicles to carry freight, express or passengers over fixed routes on public streets and highways, the franchises to be granted by a special state board, with municipal consent over routes within their boundaries, is another proposal of this committee. Still other proposals are that so far as possible municipal traffic regulations be uniform; that safety zones be raised platforms to the exclusion of white stripes or other indicators; and that no street reconstruction on business streets or major traffic ways be paid for by abutting property owners.

Statistics of methods of refuse collection—by contract and otherwise—were presented by A. P. Folwell, New York City, chairman of the Committee on Refuse Disposal, etc. In 150 cities thus far reporting garbage is collected by the city in 35 per cent, by contract at city expense in 25 per cent, by some sort of city arrangement but at private expense in 19 per cent, and is left entirely to householders in 2 per cent of the cities. For ashes the corresponding percentages are 27, 5, 5 and 63.

An afternoon and evening were devoted to street lighting combined with an automobile trip to the plant of the National Lamp Works at Nela Park, Cleveland, for both a daylight and lamplight inspection of ornamental street lighting equipment. A buffet dinner was served at the works, after which there was a committee report and paper on street lighting. During the convention moving pictures were shown of International steel twin-tie track construction and of White trucks engaged in snow removal.

Coal Miners Demand Present Wages for Two Years More

Continuation of the present wage scale until March 31, 1925, and a 6-hr. day through a five-day week with time and one-half for overtime are included in the program adopted by the policy committee of the United Mine Workers. These will be the basis of negotiations between the miners and the operators next January when a new contract will be formulated to become effective April 1, 1923.

Two operators and two miners from each of the 27 organized mining districts will meet in conference in Chicago in the middle of November to plan a readjustment of the methods used for wage negotiation. This committee is to submit its recommendations to a joint conference between the operators and miners not later than Jan. 3, 1923, and the actual wage negotiations on the agreed basis are to commence not later than Jan. 8.

The conference of operators and miners at Cleveland has decided to give up the idea of a committee of inquiry within the industry and to co-operate with the governmental fact-finding commission. The miners have acceded to the request of the President for names of candidates for this commission, but the operators have declined to so.

No action has been taken by the miners union with regard to the anthracite mine workers whose contract will expire in the fall.

Agree on Reciprocal Registration Between States

Articles of agreement governing reciprocal registration between states for professional engineers were ratified after three years consideration by the council of State Boards of Engineering Examiners at the annual meeting, Oct. 2 and 3 in Chicago, attended by delegates from 16 of the 21 states having registration laws. Standards of qualification as high or higher than required by any one state were agreed upon. Certification from one state to the other will be granted by submission of evidence as to the qualifications of the applicant and registration will be recorded without further examination. If ratified by the various state boards of engineering examiners the articles of agreement will relieve the necessity of changing various state laws and should make for the convenience of practicing engineers.

The council also passed a resolution urging that the necessary changes in state laws be made so that an engineer registered in one state may be granted reciprocal registration in another state without paying a second registration fee. Consideration was given also to providing mutual reciprocal arrangements with Canada and Mexico.

The terms of the agreement are substantially as published in *Engineering News-Record* of July 27, 1922, p. 156. Modifications adopted in the present draft provide that reciprocal registration shall be granted only to applicants already licensed in some state which is a member of the council, that a professional record properly attested and accompanied by references from three registered engineers shall be filed with the applicant's board of examiners, and shall constitute the basis of the examination, that applicants shall be qualified to design as well as to direct engineering operations, that graduation from an engineering school shall be accepted as equivalent to four years of practice instead of two and that registration shall be by card rather than by seal on the original state certificate. The articles as adopted do not include the provision in the tentative draft for accepting seven years of experience instead of ten when that experience has been of exceptional character; neither do they provide for accepting in lieu of examination the references of three licensed practising engineers.

The officers elected for the ensuing year are as follows: John T. Cox, Ann Arbor, Mich., president; O. Laurgaard, Portland, Ore., vice-president; P. H. Daggett, Chapel Hill, N. C., secretary-treasurer.

L. V. R.R. Restores Piece-Work

In announcing that it had come to an agreement with its shop workers who have formed their own company union, the Lehigh Valley R.R. states that the wage agreements provide for a sliding-scale basis of pay by which the more highly skilled mechanics receive a rate commensurate with their services, while the employment of helpers at rates somewhat lower than those paid to full-fledged mechanics is permitted. There is no provision against the payment of bonuses to efficient workmen for increased production and all of the restrictive features of the national agreement have been eliminated.

The Engineer in Public Life

FREDERICK L. FORD

Although Frederick L. Ford, former city engineer of Hartford, Conn., is now in the general contracting business at New Haven, Conn., specializing in road construction, he has been a holder of many public offices, including membership in the Connecticut Legislature, and has accepted and declined numerous public appointments. Born at North Branford, Conn., in 1871, he was graduated from the Sheffield Scientific School, Yale University, in 1893, and after three years of service with A. B. Hill, consulting engineer, New Haven, he became assistant city engineer of Hartford in 1896 and was promoted to become city engineer in 1902, a position which he held for nine years. In 1911 he became a member of the consulting firm of Ford, Buck & Sheldon at Hartford. A year later, however, the city of New Haven sought his services as city engineer and in accepting this appointment he took charge of about $1,000,000 worth of city paving, sewer, and bridge construction.

Among Mr. Ford's public appointments are: engineer member of the State Arsenal and Armory Commission of Connecticut to which he was named by Governor Henry Roberts in 1905; the special commission appointed by the Secretary of State for improvements to the State Capitol at Hartford; the Technical High School Commission of Hartford; and the state commission appointed by Governor Lake to meet with similar commissions from all the New England States on the petition of the New England railroads for a 10-per cent advance in rates. Commissions similar to the one just named have recently been created to consider the proposed consolidation of New England railroads and Mr. Ford has been named by Governor Lake as a member of the Connecticut commission.

During 1909 Mr. Ford, then city engineer of Hartford, was sent abroad for a ten weeks' study of civic and municipal problems in England, Scotland, Belgium, Holland, Germany, Austria, and France, and from the data secured during this trip prepared an illustrated monograph for the State Rivers and Harbor Commission on public docks and dock facilities.

In 1920 Mr. Ford was elected representative from New Haven to the Connecticut Legislature and served as chairman of the joint standing committee on cities and boroughs. During the session this committee reported out and the legislature passed about 225 bills relating to town, borough, and city charters.

At the present time Mr. Ford is devoting his attention to his road contracting business and has work in hand in half a dozen localities in Connecticut.

Thornton Named as President of Canadian National Rys.

The Canadian government has appointed a new board of directors for the Canadian National Ry. headed by Major-General Sir Henry Thornton as president and general manager, the other directors being Richard R. Gough, Toronto; Ernest R. Decary, Montreal; James Stewart, Winnipeg; John H. Sinclair, New Glasgow, N. S.; Frederick G. Dawson, Prince Rupert, B. C.; Tom Moore, president of the Trade and Labor Congress of Canada, Ottawa; Graham A. Bell, Deputy Minister of Railways and Canals, Ottawa; and Gerard G. Ruel, formerly general counsel of the Canadian Northern Ry.

Two vice-presidents in charge of operation and traffic are to be appointed by the board. Sir Henry Thornton is president of the Great Eastern Ry. in England. He was born at Logansport, Indiana, in 1871 and graduated in engineering at the University of Pennsylvania in 1894. He received his training on the Pennsylvania R.R. and was superintendent on the lines west of Pittsburgh, later becoming general superintendent of the Long Island R.R. In April, 1914, he went to England to become general manager of the Great Eastern Ry., which during the war became one of the most important lines of military communication. Sir Henry held several highly responsible positions in connection with army transportation and in 1918 was made Inspector General of Transportation with the rank of major-general. He was naturalized as a British subject in 1919 and was created a Knight Commander of the Order of the British Empire. Sir Henry Thornton is a member of the Institution of Civil Engineers, the Institute of Transportation, the American Society of Mechanical Engineers and other scientific bodies. He has signed a contract with the government for three years at a salary of $50,000 a year.

Work Progresses on Muscle Shoals

Under the $7,000,000 appropriation granted by Congress in the last session construction has started again on the Muscle Shoals work, under the direction of the Corps of Engineers, U.S.A. Every effort is being made at Wilson Dam to complete the excavation in cofferdam No. 2 and get the concrete in before high water. At present the work is being delayed somewhat by the difficulties of securing cement, sand and gravel. Progress would have been halted almost entirely had the Corps of Engineers not owned some eighty box cars. These box cars were handled in solid trains accompanied by convoys of army men and used exclusively to bring in cement supplies. In this way it has been possible to avoid any serious slowing down of the cement work. Sand and gravel for this job come from a point down the river. Owing to the unusually low stage great difficulty has been experienced in getting the floating equipment over the shoals.

As early next season as the water will permit, it is planned to close the south channel and work actively in that cofferdam and in the powerhouse cofferdam. Unless unforeseen difficulties should arise, it is believed that the dam will be completed early in 1925.

Illinois Central R.R. to Install Direct Current at 1,500 Volts

President Markham of the Illinois Central R.R. has announced the adoption by that road of the direct-current system at 1,500 volts for the electrification of its lines within the city of Chicago. This decision embodies the recommendations of a committee of engineers who have been studying the proposal since 1920 and is expected to exercise considerable influence on future terminal electrification in Chicago. The announcement of the decision was delayed by the death of A. S. Baldwin, vice-president in charge of terminal electrification, who had just returned from a detailed inspection of European installations. His duties have been assumed by D. J. Brumley.

The Illinois Central problem involves a heavy suburban passenger service, freight transfers between yards, switching in congested yards and eventually through passenger movements, all within terminal limits only. It is quite different from any electrification so far undertaken either in this country or abroad. The suburban passenger service will cover the main line from Chicago to Matteson, 28 route-miles; the Chicago branch, 4½ route-miles, and the Blue Island Branch, 4.4 route-miles. The track-miles involved are 125.

The suburban service is to be electrified by 1927, the freight service between 1930 and 1935, and through passenger service by 1940. Track depression now under way at a cost of $1,000,000 is to be followed by rearrangement of suburban tracks and construction of a new main passenger terminal and separate suburban terminal.

In a short time after the electrification is completed it is estimated that 240 cars electrically equipped will be required. The number of trains per day will be about 350 and the total suburban train movement will amount to about 5,000 train-miles per day.

The freight service north of Roosevelt Road, next on the program, will cover more than 40 miles of track, and as this is mainly yard trackage it involves difficult electrification problems.

Engineers Confer on Paving for Streets Having Railways

Pavement construction for streets having street railways and the character and the amount of pavement deterioration due to street-car traffic were considered at a conference of street railway and paving engineers held at the Philadelphia Engineers Club, Oct. 9. Location of utilities in streets; design of street railway structure; paving and drainage of streets for street-railway traffic; and to what extent pavement is affected by street railway traffic, were the nominal subjects for discussion. As a matter of fact remarks often wandered afield into pavement design in general and the effect of heavy truck traffic on pavement.

Theoretically the perfect location of utilities is: street railways in the center and all other utilities at the sides or under the sidewalks. It was agreed that wherever possible this plan should be followed in new construction. In extensions of streets into outlying territories being developed, many cities are now locating also subsurface utilities at the sides leaving the center clear of other structures than the railway track. This clean-cut separation is less practicable in built-up sections and particularly in the older heavily built-up business sections of the larger cities, but even here consistent effort can do much. In Philadelphia, even in the older and narrower streets, many of the utilities other than street railways as they are rebuilt are being relocated at the street sides; on occasions space has been condemned to accomplish this relocation.

Opinion on truck design ranged from the advocacy of perfectly rigid construction on a massive concrete base to flexible construction on ties and ballast, with the street-railway engineers reluctant to concede that the track or car traffic had any considerable deteriorating effect on the pavement and the city paving engineers contending that they were prime causes of pavement destruction. Many examples of pavement failure attributed to the action of street railway track were cited and shown by pictures. Failures developed first at joints and more particularly at crossings which were approximately at right angles. From these points they progressively spread. As explained by the city paving engineers, the vibration of the rails at joints and crossings are the causes.

While assenting to the claim that poor track construction contributed to pavement failures the street-railway engineers pointed out that many of the poor details of such practice had been or were being corrected and there was considerable promise that the future would show decidedly improved results. They insisted, however, that correspondingly better paving structure was needed. With modern truck loads, there should be thicker pavement, better foundations and far better drainage. Indeed it was the general attitude of the conference that paving practice generally had to be materially advanced to meet the present traffic loads and speeds.

Engineering Societies

Calendar

Annual Meetings

RAILWAY BRIDGE AND BUILDING ASSOCIATION, Chicago; Annual meeting Cincinnati, Oct. 17-19.

AMERICAN PUBLIC HEALTH ASSOCIATION, New York; Annual Convention, Cleveland, Oct. 16-19.

The Western Society of Engineers was addressed Oct. 2 by Jacob L. Crane, Jr., municipal development engineer, on "What Chicago Can Do Under the City Plan" and Oct. 9 by Floyd W. Parsons, editor-director *Gas Age Record*, on "Looking Ahead in the Fuel Industry." The program for the remainder of the month is as follows: Oct. 16, "Radio Broadcasting" by W. R. G. Baker, General Electric Co.; Oct. 23, a symposium of four papers on train control; Oct. 30, "Material Handling" by K. A. Wood, Cowan Truck Co.

The Minnesota Section of the American Water Works Association will hold its fall meeting Oct. 27 in Minneapolis at the University of Minnesota.

The Iowa Section of the American Water Works Association will hold its annual meeting Nov. 1, 2 and 3 in two cities, the first day in Iowa City and the two following at Cedar Rapids. An exhibition of water-works equipment and supplies will be held at the latter city. Jack J. Hinman is secretary-treasurer of the section but H. F. Blomquist, superintendent, Cedar Rapids Water Works, has charge of the exhibition.

The American Society of Civil Engineers at its meeting of Oct. 4 in New York discussed two papers, one on "Experiments with Models of the Gilboa Dam and Spillway," by R. W. Gaussmann and C. M. Madden and another on "Engineering Geology of the Catskill Water Supply," by Charles P. Berkey and James F. Sanborn. Both papers were printed in the September *Proceedings*.

Personal Notes

RUHLING & HOLDSWORTH, consulting civil and and municipal engineers, Detroit, Mich., announce the admission to partnership of HARRY L. HUDSON, formerly of the Detroit city engineer's office, and recently associated with the above firm. The business will be conducted under the firm name of RUHLING, HOLDSWORTH & HUDSON.

FRANK KESSING has severed connections with Kopf & Wooling, architects, Indianapolis, Ind., and has been appointed engineer for the Keynote Manufacturing Co., Indianapolis, manufacturers of septic tanks.

C. O. TALCOTT was elected highway commissioner of the Town of Glastonbury, Conn., at the annual town election held Oct. 2.

CARL CHRISTIANSON, who has been superintendent of construction for Grant Smith & Co., on the Washington Water Power Company's new Upper Falls power plant since January, 1921, has accepted a position as superintendent on the Skagit River power plant, being built by the City of Seattle.

CARL R. CAMP has resumed the business of general contracting and engineering, with offices in the Fuller Building, Philadelphia, which he engaged in prior to the World War.

THE HEFFNER ENGINEERING CO. is opening an office in Pikeville, Ky., to engage in mining and civil engineering. The chief engineer and president of the company is Earle B. Heffner, formerly chief engineer for the McKinney Steel Co., Wolfpit, Ky.

WALTER A. SPERRY, chief chemist at the Grand Rapids filter plant, has been appointed by City Manager Locke to be director of public service, succeeding GERALD J. WAGNER, who has resigned. LLOYD BILLINGS, assistant chief chemist, has been appointed to the position vacated by Mr. Sperry.

JAMES E. HANLON, formerly with Lockwood, Greene & Co. of Boston for many years, has opened an office in Boston, as an architectural engineer.

R. E. KELLER, of Crockett, has been appointed county engineer of Johnson County at Cleburne, Tex.

M. B. HODGES has been appointed county engineer of Uvalde County at Uvalde, Tex. Mr. Hodges formerly was state resident engineer at Griggs, in Burnet County.

C. M. HOWARD, a graduate of the University of Washington in the class of 1913, has accepted the position of assistant engineer with the Upper Columbia Orchard Co., Walla Walla, Wash.

HARVEY DEEN, of Austin, Tex., a state highway resident engineer recently in Van Zant County has been appointed superintendent of federal aid projects, Texas highway department.

E. BRYSON TUCKER has resigned from the power and mechanical department of the Consolidation Coal Co., Fairmont, W. Va., and is now with the A. S. Aloe Co. of St. Louis, Mo., importers and manufacturers of engineering instruments and supplies.

BEN F. DUPUY has succeeded as city engineer of Glendale, Calif., C. L. HILL, who has resigned to enter private practice.

A. J. HAMMOND has resigned as assistant chief engineer of the Chicago Union Station Co. and has become associated with James O. Heyworth and O. M. Strehlow in the engineering and contracting business. From 1891 to 1898 he was engaged in municipal engineering. After three years as assistant engineer on the Vandalia Ry. he returned to municipal work for eight years as city engineer of South Bend, Ind. During this period he was also chief engineer of the Northern Indiana Ry. and Southern Michigan Ry., and bridge engineer for the St. Joseph Co. In 1910 he became consulting engineer for Chicago on water tunnels and remained in the service of the city the three following years as engineer of bridges and harbors and chief engineer of the bureau of public efficiency. Mr. Hammond is president of the Illinois section of the American Society of Civil Engineers.

OBITUARY

ALAN TIMBRELL, resident engineer of the Ontario provincial highways department, died at Simcoe, Ont., on Oct. 3. Mr. Timbrell was born in England and was a member of the Engineering Institute of Canada.

THOMAS KING, a retired civil engineer, died at Wichita, Kan., on Sept. 25, aged eighty-nine. For twenty-five years he was with the A. T. & S. F. Ry. at Galveston, Tex.

FRANK S. WASHBURN, chairman of the board of the American Cyanimid Co., and a former trustee of Cornell University, died Oct. 9 at Rye, N. Y., aged 62 years. Mr. Washburn was graduated from Cornell in 1883. After considerable railway engineering in the Middle West he engaged in engineering construction work incident to the development of New York City's water supply. He was a member of the American Society of Civil Engineers and other technical bodies.

From the Manufacturer's Point of View

Lumber Industry Adopts Program for Standardization

Agreement has been reached by the central committee on lumber standards, which was appointed by the several branches of the industry last July, to formulate a program for simplification of the industry. It is planned (1) to collect and analyze all information that will aid in the simplification of sizes, grades, and names of lumber products; (2) to submit these findings to the producers, distributors, and consumers by means of the associations in these fields; (3) to promote discussion of the questions involved and to harmonize differences of opinion; (4) to establish a grade-marking and inspection service that will guarantee to the consumer the quality and quantity of his lumber purchases; and (5) to arrange a national conference of representatives of all branches of the industry which would finally adopt specific practices in these fields that will conform to the requirements of the Department of Agriculture and the Department of Commerce.

Contractors and Manufacturers Discuss Equipment Problems

Service on repair parts and standardization of equipment were discussed at a conference in Detroit, Oct. 3, of the executive and advisory boards of the Associated General Contractors and representatives of a score or more of prominent equipment manufacturers. The purpose of the conference was to arrive by frank discussion at a mutual understanding of the problems of the maker and the user of construction plant and materials and to create a joint committee to work out their solution.

An afternoon and an evening dinner session were held and a committee of fifteen was appointed to prepare a program for a future meeting and to formulate plans for investigation and research. The committee expects to call a second conference and present a preliminary report within the next two or three months.

Metal Lath To Be Standardized

Following the reduction in standard sizes of paving brick and lumber initiated by the Department of Commerce, work is now under way in the standardization of metal lath. A reduction from seventy-one to nine in the number of weights and styles of lath was recommended at a preliminary conference held at the Department of Commerce Oct. 2. The manufacturers have worked out a plan for this reduction which they believe will be acceptable to contractors and other consumers.

A general conference will be held Dec. 12 to which manufacturers, distributors and consumers will be invited. At that conference, it is expected that a definite conclusion will be reached.

Engineers Endorse Reduction of Asphalt Grades

Thomas H. MacDonald Chief of U. S. Bureau of Public Roads, for Greater Uniformity

FURTHER comment on the subject of fewer varieties of asphalt for road and paving work, presented in an article in *Engineering News-Record*, Sept. 28, p. 539 follows:

THOMAS H. MACDONALD
Chief, U. S. Bureau of Public Roads, Washington, D. C.

With reference to the article in the Sept. 28 issue of *Engineering News-Record* entitled, "Too Many Grades of Asphalt Specified, Say Producers," we are in agreement with the idea that a comparatively limited number of grades of hardness of asphalt should be satisfactory for the standard types of bituminous road construction in this country. The penetration limits mentioned in this article agree with our present typical standards except that we now have a grade ranging from 70 to 80 penetration for one-size stone bituminous concrete construction in the South and coarse graded bituminous concrete in the North, and at the present time we do not specify a lower limit of 30 except for joint filler.

It is quite natural that there should be a wide difference of opinion as to what specification limits are best adapted for different classes of construction in different parts of the country through a wide range of climatic conditions. The differences noted in the various specifications to some degree reflect the views of individual engineers who have studied their particular local conditions. In many cases the variations are so small that the same grade of asphalt would satisfy all of the specifications notwithstanding these variations.

The technical committees of the American Association of State Highway Officials are now working on various specifications including those for asphalt for construction, and no doubt standards will result from their work which will require the production of a comparatively limited number of grades of asphalt if these standards are universally adopted by the states. Attention, however, should be called to the fact that the specifications of the various specification-producing organizations are not mandatory, but are merely expressions of collective opinion from which there may be many dissenting views.

F. W. SARR
First Deputy Commissioner, New York State Highway Department, Albany, N. Y.

Commenting on the range of penetration suggested in *Engineering News-Record* of Sept. 28 for the proposed 7 standard grades of paving asphalt, I am of the opinion that the proposition of standardizing has considerable merit and the range of penetration of each of the grades would appear to be sufficient

from the engineer's point of view. Providing the refiners can produce material within the narrow limits specified for the lower penetration material, it would seem that the engineer should be satisfied to specify such limits.

It is respectfully suggested that the standardization proposed in the article be brought to the attention of the proper committees in the American Society for Municipal Improvements and the Association of State Highway Officials. It would seem that there should be no objection to the adoption by such committees of the proposed standardization of the several grades of paving asphalt.

A. W. DEAN
Chief Engineer, Division of Highways, State Department of Public Works, Boston, Mass.

I am heartily in accord with the idea of having fewer grades of asphalt called for by specifications. It is my belief that the users of asphalt would derive much benefit if either the 7 grades suggested by the asphalt manufacturers or those suggested by the American Society of Testing Materials were adopted.

The manufacturers could, if they would, furnish material at a lesser price, and I cannot conceive of any highway specifications that would not admit one of the 7 grades mentioned and give satisfactory results.

I believe that your magazine would be doing a public good if it contributes toward bringing about greater uniformity in asphalt specifications.

R. A. MACGREGOR
Assistant Engineer, Department of Public Works, Manhattan, New York City

It would seem to be a highly desirable attainment to reduce the variations in required characteristics of asphaltic cements. Standardization to a reasonable extent will always tend to economy and it is no doubt due to failure on the part of engineers to appreciate the difficulties of producers and the added costs that so many and so slight variations are called for.

From the table accompanying the article on p. 540 of your issue of Sept. 28, it is evident that the difference between two specifications for, say, penetration is often less than the tolerance that must be allowed above and below a given penetration. The same remark would apply to most of the other columns.

The argument is good that the variations in aggregates which constitute about 90 per cent of the pavement, are necessarily much greater than can easily be obtained in the asphaltic cement and that therefore it is a waste to attempt to control the asphalt cement so closely. This applies especially to the bituminous concrete composed of crushed stone or gravel for which the specifications tabulated are drawn.

The A. S. M. I. is now working toward fewer and simpler specifications and the article is timely, in view of the meeting of that society last week.

Further discussion of grades of asphalt, by Major F. S. Besson, Washington, D. C., and Julius Adler, Philadelphia, will appear in next week's issue.

Manufacturers Plan for Next Good Roads at Chicago

As a result of conferences between representatives of the Highway Industries Exhibitors Association and the American Road Builders Association, a convention committee composed of Charles M. Upham, state highway engineer of North Carolina; James H. McDonald, consulting engineer, Hartford, Conn., and S. F. Beatty, vice-president and general manager, Austin-Western Road Machinery Co., Chicago, has been named to control the next Good Roads Show to be held in Chicago, Jan. 15-19, 1923. Arrangements for the show are to be entirely in the hands of the exhibitors' committee. C. W. Kelley has been appointed director of exhibits, with offices in the Wrigley Building, 400 North Michigan Boulevard, Chicago, and all negotiations for space will be conducted through him. Allotments will be made in November.

The Good Roads Show will be staged in the Coliseum, but the convention sessions will be held elsewhere to avoid the necessity of shutting down the machinery on exhibit while the technical meetings are in progress.

Business Notes

REPUBLIC MOTOR TRUCK CO., Alma, Mich., has issued the following statement regarding the appointment Sept. 28 of the Security Trust Co. of Detroit, as receiver for the company: "The appointment by Judge Tuttle of the Federal Court at Detroit, was with the concurrence of the company and its largest creditors and is a step necessary in connection with the carrying out of a plan of reorganization. The business will be continued with Colonel Smith in charge of operations, and the details of the proposed plan of reorganization will be made public as soon as practicable. The REPUBLIC TRUCK SALES CORP. is in no way affected by the receivership of the parent company and will continue to handle its business as previously, in charge of the same management."

THE BROWN HOISTING MACHINERY CO., Cleveland, announces the appointment of E. P. Sawhill to take charge of its conveyor sales. Mr. Sawhill has had 30 years' engineering and selling experience on this type of equipment. The line he will handle for the Brown company includes belt conveyors, chain conveyors, coal crushers, screens and apron conveyors.

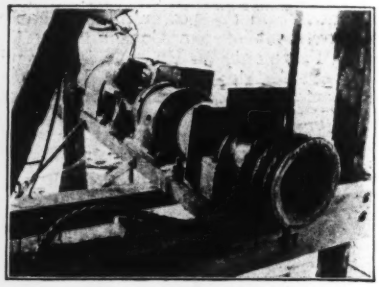
JOHN A. ROEBLING'S SONS CO., Trenton, N. J., put into effect Sept. 1 an employees' group life insurance and pension plan, graded according to length of service up to a maximum of $1,500 for eleven years of service or more. All employees more than one year in the company's service are insured for $500, this amount increasing by $100 for each additional year of service.

FOUGNER CONCRETE STEEL CO., New York, has sold its business to the Paul J. Kalman Co., Chicago, which will continue under its own name the business of engineering, manufacture and sale of reinforcing steel and allied products. The New York office, of which L. O. Helgeser is manager, will be moved from 29 Broadway to 110 East 42nd St. The entire organization of the Fougner Co. will be retained by the Kalman Co.

Equipment and Materials

Electric Caisson Hoist Unit

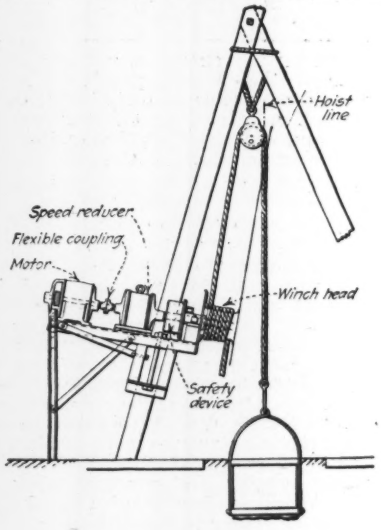
Unit hoists electrically operated for raising material from trenches, tunnels or open well caissons for building foundations are being used in Chicago instead of the usual endless cable operating a nigger-head at ten or twelve caissons. Should any difficulty with the cable arise, such as engine trouble, stranding or a worn shear, the entire



operation is at a standstill. Until all of the caissons are complete the power plant and operator for the whole work must be maintained.

By the unit system tripods are equipped with individual machines each operated by a 2-hp. motor controlled by the man on top. The machine has the necessary nigger-head with normal speed of 55 r.p.m., safety back-up device and a speed regulator for use in case wet wells are encountered and greater than normal speed is desirable.

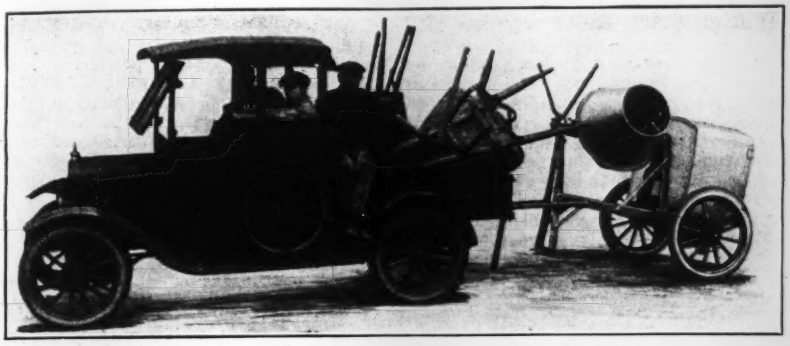
Assuming the normal 6-weeks period for an ordinary caisson job, Falzer & Webber, equipment engineers, the makers of the machine, on which patents are pending, claim a monetary saving of $1,700. The machine has been used on trench work by the Henry Ericsson Co. on the Illinois Merchants Bank Building, by the W. J. Newman Co. on a caisson foundation job and by



the R. C. Wieboldt Construction Co., on tunnel operations on the Chicago Union Station job.

Light Weight Trailer Mixer

A light weight trailer-mixer in two types, two-wheel and four-wheel, equipped with pneumatic tires has been

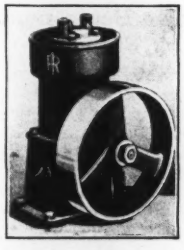


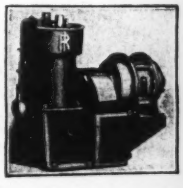
developed by the Jaeger Machine Co., Columbus, Ohio. The two-wheel type is simply the standard Jaeger 3-E mixer designed for trailer use. Its weight is 985 lb. In place of front wheels there is a steel support to hold the machine level while mixing.

Mobility is one of the chief features of this mixer. When ready to move it is merely necessary to attach the trailer to a truck or automobile and, with the pneumatic tire equipment, speeds of 20 to 30 miles an hour can be made. The mixer itself is of the revolving-drum batch type, driven by a 2-hp. gasoline engine. The capacity per batch of the 3-E two-wheel model is 2½ cu.ft. and of the 4-E model, four wheels, 4½ cu.ft. of mixed concrete.

Small Vertical Belt-Driven Air Compressors

A new line of small vertical belt-driven air compressors, known as Type 15, is announced by the Ingersoll-Rand Co., New York. In addition to the





plain belt-drive design, each size is built as a self-contained electric motor outfit driven through pinion and internal gears by a short belt-drive.

Among the features of these compressors are a constant-level lubrication system, a constant-speed unloader for the plain belt-drive machines, a centrifugal unloader for start and stop control machines, and an increased size of water reservoir cooling pot.

The smallest size compressor is built with either ribbed cylinder for air cooling, where the service is intermittent, or a water-jacketed cylinder of the reservoir type for constant service. All other sizes are water-jacketed.

Wire-Rope Cutter for Field or Shop Use

For cutting wire rope quickly, cleanly, cheaply and without the use of heavy and expensive equipment, the A. Leschen & Sons Rope Co., St. Louis, announces the Burch patented wire-rope cutter, shown in the accompanying illustration. The device consists of a body and a base casting, both of high grade steel, guaranteed not to break. High-carbon steel is used for the cutter blade and the lower cutting die and is properly tempered to insure long life and clean cut ropes.

Equipped with the base plate, the cutter can be used out on the job, although the stem of the body casting is made to fit the hardy hole of an anvil, thus permitting the use of the device in shops. Two cutting edges are a feature of the dies, so that when one is dulled the die can be reversed and its service doubled. The gross shipping weight of the complete cutter, with base, is 32 lb. It may be employed to cut wire hoisting and haulage ropes of all sizes up to 1-in. diameter.

Publications from the Construction Industry

Surveying Instruments—WARREN-KNIGHT CO., Philadelphia, has issued a 32-p. illustrated catalog of its engineering field instruments, drafting-room furniture and drawing materials. Sterling transits and levels are featured. For combined level and stadia work the company recommends its new disappearing stadia arrangement which permits the cross wires to be focused either with or without the stadia. The transit types include precision, light mountain, surveyors and contractors, and reconnaissance types. There is also a builder's level convertible into a sighting transit.

Gypsum Roofs—H. E. MARKS CORP., Pittsburgh, in a 16-p. illustrated booklet, sets forth construction details of gypsum roofs of both the poured-in-place and the pre-cast slab types. The outstanding feature of the Marks system, it is pointed out, is the production of a monolithic, poured-in-place slab, eliminating drip during erection and the necessity of building temporary forms and their supports in which to contain the aggregate. The centering is composed of steel T's and gypsum board. Reinforcement is supplied by welded wire. One of the chief claims for this type of construction is its light weight. The use of pre-cast gypsum slabs is recommened for use on extremely steep roof pitches where poured-in-place methods are not practicable. Tables are given showing safe loads for various slab sizes.

Crane Excavators—KOEHRING CO., Milwaukee, has issued two bulletins in the form of 4-p. folders illustrating and giving specifications for its No. 2 and No. 3 crane excavators, which are operated by gasoline engines. They may be equipped with either clam-shell or dragline buckets. The No. 2 machine has a capacity of 12 tons at a 12-ft. radius and is equipped with a 40-ft. boom. The No. 3 unit has a capacity of 20 tons at a 12-ft. radius and also is equipped with a 40-ft. boom. The gasoline-engine capacities are, respectively, 70 and 100 hp.

Runoff and Discharge Diagrams—CLAY PRODUCTS ASSOCIATION, 133 West Washington Street, Chicago, has published a folder of runoff and discharge diagrams for drainage work. One diagram shows the runoff in cubic feet per second from areas of from 10 to 100,000 acres with various drainage coefficients, and the other diagram covers velocities and discharges for salt-glazed vitrified clay sewer pipe and drain tile.

Ventilating Equipment—B. F. STURTEVANT CO., Boston, has issued a new 44-p. illustrated catalog on air washers. It shows the various details of construction by which the air for any building or for any industry is washed and tempered before entering the building. The motors and pumps are also described and illustrated. Installations are shown in a city hall, a chocolate factory, a customs house, a theatre as well as other types of buildings. More than 12 p. are devoted to various tables giving dimensions psychrometric charts, diagrams, relative humidities and other useful data.

Rubber Products—GOODALL RUBBER CO., INC., Philadelphia, presents descriptive text and illustrations in a new 138-p. catalog dealing with a wide variety of rubber products used in construction work. These include semi-metallic and rubber hose, power transmission and conveyor belting, molded rubber products such as pump valves, diaphragms and packings. Flexibility in the semi-metallic hose is insured by the use of a special joint. Many different types of hose are manufactured for such purposes as steam and air drill work, grouting, pile-driver use and pumping. One section of the book is devoted exclusively to fire hose.

Line Shafting Equipment—MEDART CO., St. Louis, has issued a 193-p. illustrated catalog of its line shafting equipment, pulleys and other accessories relating to the mechanical transmission of power for manufacturing plants.

Business Side of Construction

Facts and Events that Affect Cost and Volume

Production and Materials Stocks in Nine Cities

Lumber Output Within 2 Per Cent of Normal—Steel Improving—Cement Stocks Low—No Winter Brick Reserve

Steel—Production of steel ingots, proceeding at an annual rate of about 32,000,000 tons as against 19,000,000 tons in 1921; 41,000,000 tons in 1920 and 30,000,000 tons in both 1912 and 1913, the two best pre-war years for steel tonnage. The steel output has increased perceptibly during the last two weeks, and the industry as a whole is operating at about 65 per cent of capacity as against 50 per cent in August and 75 per cent in June. Sheet mills have accumulated stocks equal to three weeks of production, owing to shortage of closed cars; but mills shipping structurals, etc., movable on flat cars, have small reserves on hand.

Lumber—An average of 371 mills reporting weekly to the National Lumber Manufacturers' Association, for the four weeks ending Sept. 23, show 927,166,273 ft. cut, 807,507,615 ft. shipped and orders for 756,224,606 ft. b.m. Production fell off one per cent; shipments 3 per cent and orders over 14 per cent as compared with the first four weeks of August. Production, according to latest reports, is 2 per cent; shipments 14 per cent and orders 17 per cent below normal.

Cement — Output during August amounted to 11,664,000 bbl. as against 11,557,000 for July, an increase of 107 000 bbl., according to the Geological Survey. Shipments increased 511,000 bbl. despite the rail tie-up, leaving a reserve of 5,737,000 bbl. on Sept. 1 as compared with 8,433,000 bbl. available Aug. 1, 1922.

Brick—Ninety-two firms reporting to the Common Brick Manufacturers' Association of America as of Sept. 1, show production, 48 000,000 brick behind orders on books, with shipments 2 000,000 in excess of production. This condition indicates a danger of again going into the winter months with no reserve stocks.

San Francisco—Plenty of sewer pipe, brick, hollow and clay drain tile and other clay products. Stocks low on cement, track supplies, wire nails and structural rivets. Large supplies of native road oils and asphalt. Fair stocks of structural steel.

Denver—No important changes during month except in cement. Car shortage causing falling off in cement supply; further delays anticipated.

Minneapolis—Stocks of various building materials fair, with the exception of cement, which is reported "sold out." Railroad situation slightly improved; stocks of sewer pipe, brick and hollow tile replenished. Empty cars holding back shipments of many commodities. Lumber situation improving.

Detroit—Cement shortage being relieved by shipments from nearby mills. Plenty available for early deliveries. Ample reserves of lime, brick and sewer pipe. Lumber supply, moderate. Large deliveries of hollow tile take several days. Very little asphalt at hand.

New Orleans—No market for asphalt and crushed stone; stocks of common brick and dynamite, small. Deliveries in hollow tile also slow. Fair demand for lumber but mills are unable to fill orders, owing to shortage of flat-cars. Yellow pine about 25 per cent normal.

Atlanta—Delays in obtaining supplies, though close at hand, owing to car situation. Deliveries in sand, gravel, sewer pipe and hollow tile take three to ten days. Plenty of common brick and pine lumber. Only two cars of steel structurals, five cars of lime and ten of cement, on sidings.

Philadelphia—Some sizes of sewer pipe still to be had in small quantities; but on most sizes market is depleted and orders are being filled from cars on sidings. Asphalt being shipped at brisk rate. Paving blocks, wood blocks, sand, gravel and crushed stone being delivered as rapidly as produced. Cement, lime and hollow tile stocks depleted. Brick producers will not accept orders for delivery in less than sixty days. Stocks of structural timbers scarce but finishing grades of lumber, fairly plentiful. Plenty of explosives and manila rope.

Birmingham—Stocks of all construction materials larger than usual, owing to lack of cars for shipping out orders.

New York—Car, labor and fuel shortages have combined to create a scarcity of sewer pipe, at sources supplying New York City. Lime and brick shortages have been completely overcome. Impossible to get lumber from mills under seven to nine weeks.

CONDITIONS OF MATERIALS STOCKS IN IMPORTANT CENTERS

Stocks on hand in approximate figures, example: (common brick, Denver, 2,000,000); time required for delivery of carload lots to city job, example: (sewer pipe, Atlanta 10 days); and stocks on hand in general terms, example: (cement, Minneapolis, sold out.)

	San Francisco	Denver	Minneapolis	Detroit	New Orleans	Atlanta	Philadelphia	Birmingham	New York
Sewer pipe	Plenty	Del. 24 hr., local plant	Improving	Ample	Enough	Del. take 10 days	Depleted in principal sizes.	Large	Shortage in certain sizes
Cement	Low	Stocks dwindling; car shortage.	Sold out	Shortage relieved.	Meeting demand.	10 cars	Low; but shipments improving.	Plenty	Stocks low.
Lime	Fair	Plenty	Ample	15 cars	Ample	5 cars	Depleted; better shipments.	Extensive	Plenty; shortage overcome.
Common brick	Enough	2,000,000	Improving	Plenty in local yards.	Insufficient	Plenty	No. del. under 60 days.	Larger than usual.	Enough; demand still good.
Hollow tile	Fair	Sufficient	Enough	Moderate; del. take several days.	Low	Del. take 10 days.	Depleted	Unusually heavy.	Not affected by car situation; del. by water.
Lumber	Delayed mill shipments.	Dealers' stocks ample.	Normal for season.	Moderate stock.	About 25 per cent of normal.	Plenty pine.	Structural timbers scarce.	Plenty pine.	Not under 7@9 weeks from mill.
Asphalt	Large reserves.	10 cars	.....	Small	No market	.....	Heavy	Ample	Refineries well stocked.
Structural steel	Fair; low on rivets.	.....	.....	.....	.....	2 cars shapes	Del. slow from Pittsburgh.	Heavier than usual.	Mill. del. affected by car shortage.

Foreign Construction Being Done By New York Firms

Three more important foreign construction projects are here added to the lists as published in *Engineering News-Record* on April 20 and June 15, respectively. The dredging project is located in South America, with the two buildings in the West Indies. The first group of contracts, published on April 20, consisted of projects under way in Cuba, Belgium and Japan. The second list, in the issue of June 15, was confined exclusively to South America. This, together with the accompanying table, showing the three latest and most important foreign jobs awarded to New York contractors, indicates the tendency of American construction forces to incline toward the tropics.

Name and Address Of Contractor New York City	Kind of Work	Where Work Is Located	Cost	When Started	Expected Completion	Name of Owner
Purdy & Henderson 45 E. 17th St.	Yacht Club	Havana, Cuba	$500,000	May 22, 1922	Jan. 1, 1923	Havana Yacht Club, Havana, Cuba.
Purdy & Henderson 45 E. 17th St.	Hotel	Nassau, Bahamas	$1,000,000	June 22, 1922	Feb. 23, 1923	Munson Steamship Co., N. Y. C.
Foundation Co. 120 Liberty St.	Dredging Canal	Cartegena, Colombia, S. A.	$500,000	Aug. 22, 1922	Aug. 22, 1923	City of Cartagena, Colombia, S. A.

Federal Aid Road Bids Compared by Geographic Divisions

Average accepted bids on Federal Aid road projects, during August, showed rates for rein. concrete construction ranging from $1.85 in New England to $2.26 per sq.yd. in Ohio. The average rate for New York was $1.08, and did not include state furnished cement, at $2.93 per bbl. The average rate, therefore, for the nation would be about $1.36 per sq.yd. for rein. concrete surfacing. Rates for plain cement concrete ranged from $1.40 in Alabama to $2.81 per sq.yd. in North Carolina, with an average for the country of $2.30 per sq.yd. The only work involving bituminous concrete surfacing was located in North Carolina at the rate of $2.70 per sq.yd. Bituminous macadam, however, cost $1.49 per sq.yd. in Virginia as against $1.84 in Ohio, 45c. in New York and 41c. in Maine, giving an average rate for the nation of $1.08 per sq.yd. Steel structurals ranged from 4c. in Ohio to 6c. in New York, with reinforcing steel at 4c. in New York and Ohio; 6@7c. throughout the South and 9c. per lb. in South Dakota, an average of 5c. per lb. for steel generally.

In the accompanying table unit-bid prices are given for items and materials furnished in place on the job. Gravel bids are listed by square or cu.yd., depending on the specifications of the various states. About $3.30 per sq.yd. represents a fair average for brick paving, throughout the country.

Car Shortage Affects Pennsylvania Highway Construction

Grave concern is felt by the Pennsylvania State Highway Department over the situation now confronting it, on account of transportation difficulties which will make it impossible to complete roadways, now in course of construction, during the present season unless some relief is afforded. The Governor conferred, on Oct. 3, with officials of the State Highway Department and members of the Public Service Commission on measures of relief.

Assistant State Highway Commissioner George H. Biles in a recent interview said:

"The progress of State Highway construction has been seriously impeded for several weeks, due to strikes, labor and car shortage and embargoes and, at the present time, the situation is very acute. On only two-thirds of the one hundred and sixty contracts now in force was paving work carried on, the past week. Reports received at the main office today indicate that contractors on over half of the program are about to the point of exhaustion in the supply of materials.

"One week ago there was only sufficient material stored on these contracts to take care of about twenty-two miles of pavement. When it is considered that this is distributed among a large number of contractors, it will be but a few days until they will be entirely out of material resources and unable lay pavement.

"Everything is being done to alleviate the situation but under these abnormal conditions efforts are apparently of no avail. If there is no early change for the better, sections of highways on our main thoroughfares, in which are included many borough streets now under construction, will be in practically an impassable condition during the winter months."

Next week—résumé of recent public bond sales, showing rate, yield, price and by whom handled.

STATEMENT OF AVERAGE ACCEPTED BID PRICES ON FEDERAL AID PROJECTS DURING AUGUST, 1922

ITEMS AND MATERIALS FURNISHED IN PLACE ON PROJECT

Geographic Divisions and States	Surfacing: Gravel Sq.Yds.	Gravel Rate	Bit. Macadam Sq.Yds.	Bit. Macadam Rate	Bit. Concrete Sq.Yds.	Bit. Concrete Rate	Pl. Cement Conc. Sq.Yds.	Pl. Cement Conc. Rate	Re. Cement Conc. Sq.Yds.	Re. Cement Conc. Rate	Steel: Reinforcing Lbs.	Reinforcing Rate	Structural Lbs.	Structural Rate	Cement Furnished by State: Barrels	Cement Furnished by State: Rate
Totals for all States	161,460	0.43	765,026	1.08	168,890	2.70	393,145	2.30	131,077	1.36	3,593,903	0.05	421,040	0.05	56,980	2.93
New England			38,505	0.41					39,924	1.85	345,400	0.05				
Maine			38,505	0.41					39,924	1.85	345,400	0.05				
New Hampshire																
Vermont																
Massachusetts																
Rhode Island																
Connecticut																
Middle Atlantic			133,056	0.45			7,875	*1.46	85,885	*1.08	777,200	0.04	11,750	0.06	56,980	2.93
New York			133,056	0.45			7,875	*1.46	85,885	*1.08	777,200	0.04	11,750	0.06	56,980	2.93
New Jersey																
Pennsylvania																
East North Central			82,382	1.84			30,196	1.47	5,268	2.26	1,207,048	0.04	320,890	0.04		
Ohio			82,382	1.84					5,268	2.26	1,177,153	0.04	320,890	0.04		
Indiana																
Illinois																
Michigan																
Wisconsin							30,196	1.47			29,895	0.05				
West North Central											386,004	0.05				
Minnesota											384,367	0.05				
Iowa																
Missouri																
North Dakota											1,637	0.09				
South Dakota																
Nebraska																
Kansas																
South Atlantic	23,100	0.50	111,083	1.49	168,890	2.70	315,857	2.44			314,550	0.07				
Delaware																
Maryland	23,100	0.50					166,250	2.14			64,016	0.07				
Virginia			111,083	1.49							22,944	0.07				
West Virginia																
North Carolina					168,890	2.70	132,770	2.81			227,590	0.06				
South Carolina							16,837	2.43								
Georgia																
Florida																
East South Central							617	1.40			206,771	0.05				
Kentucky																
Tennessee																
Alabama							617	1.40			206,771	0.05				
Mississippi																
West South Central											261,750	0.06				
Arkansas											74,700	0.07				
Louisiana																
Oklahoma																
Texas											187,050	0.05				
Mountain	138,360	0.24									83,180	0.07				
Montana																
Idaho																
Wyoming											83,180	0.07				
Colorado																
New Mexico																
Arizona																
Utah																
Nevada	138,360	0.24														
Pacific							38,600	2.08			12,000	0.06				
Washington																
Oregon							38,600	2.08			12,000	0.06				
California																

Prices of items or materials containing State furnished cement and bitumen which was not included in total cost of the item are marked thus—*

Projects Under Consideration at Vancouver

Staff Correspondence

In the city of Vancouver, B. C., several engineering projects have been receiving detailed attention of late and are frequently accorded front page treatment in the daily press. Prominent among these are: (1), the decision to investigate the development of a municipal hydro-electric project for which purpose the city has selected a consulting engineer, as noted elsewhere in this issue; (2), the proposal of the McClintic-Marshall Co. of Pittsburgh, Pa., to build a bridge for $1,240,000 across the second narrows to connect Vancouver and North Vancouver, and preliminary plans for which have been approved by the Dominion engineer of public works; (3), the recent sale of a $300,000 sewer bond issue with the proceeds of which extensions to the greater Vancouver joint sewerage system in the south part of the metropolitan district are to be made; (4), the proposal to form a Greater Vancouver Joint Water Commission so that the seven adjoining municipalities who share the Vancouver water supply may participate in financing needed extensions of the main supply system; (5), the proposal to pave the highway from Vancouver to the international line so the city may share in the business brought by the rapidly increasing number of automobile tourists that come from eastern points to all parts of the Northwest that are accessible on good roads; and (6), ways and means of replacing or maintaining a considerable part of the 800,000 sq.yd. of wood block paving in the city which has given considerable trouble due to swelling and buckling of pavements when wet weather comes after periods of drought.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of October 5; the next, on November 2.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	+$3.14	$3.65	$4.20	+$3.02½	+$3.15	$3.80	$3.25	$3.75	$3.75
Structural rivets, 100 lb.	3.85	4.35	6.00	3.35	+3.77½	4.80	4.50	+5.00	6.50
Reinforcing bars, ¾ in. up, 100 lb.	+3.04	3.50	3.50	+2.92½	+3.05	3.97½	3.00	3.75	3.25
Steel pipe, black, 2½ to 6 in. lap, discount	57%	61.15%	45%	59½%	58.9-5%	43%	47.9%	45%	30.00
Cast-iron pipe, 6 in. and over, ton	55.30	49.00	51.50	+48.70	+55.50	60.00	51.00	+54.00	+55.00
Concreting Material:									
Cement without bags, bbl.	2.60	2.54	2.25	2.20	2.39	2.85	2.71	2.90	+2.88
Gravel, ¾ in., cu.yd.	1.75	2.00	2.25	2.00	1.75	1.75	2.25	1.00	1.50
Sand, cu.yd.	1.00	1.35	2.25	2.00	1.00	0.75	1.50	1.00	1.25
Crushed stone, ¾ in., cu.yd.	1.75	1.90	1.65	1.60	2.25	3.50	2.25	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	59.00	42.00	40.00	+51.00	+41.00	39.75	+35 00	24.50	50.00
Lime, finishing, hydrated, ton	15.80@16.17	23.00	25 00	18.00	29.00	24.00	22.00	24.00	21.00
Lime common, lump, per bbl.	2.75@3.14½	+1.85	2 50	1.40	1.40	2.70	1.75	2.80	11.00
Common brick, delivered, 1,000	18.00@—19.10	12.00	10 90	11.00	18@19	12.00	15.00	14.00	16.00
Hollow building tile, 4x12x12, per block	Not used	.0776	.115	.1101	.09	065	....	.11	.08
Hollow partition tile 4x12x12, per block	+.1230	.0776	.115	0808	....	065	.108	.11	....
Linseed oil, raw, 5 bbl. lots, gal.	+.93	—.97	1.13	.97	1.00	—1 08	1.04	.86	—1.06
Common Labor:									
Common labor, union, hour	.60	.35	.....	.....	.....	.50@.55	.56¼	.50@.60	....
Common labor, non-union, hour	.44@.60	.30	.25	72½	.35@.50	.35@.50	.47½@.50	....	.30@.35

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b. Cement and concrete laborers' rate, 81½c.; pick and shovel men, 60c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.55 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on Douglas fir instead of pine. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at par.) Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½-in., $30; 6-in., $110.

Changes Since Last Week

Steel shapes and reinforcing bars up 10c. per 100 lb. in New York, Chicago and Minneapolis warehouses, during last fifteen days. Seattle advanced structural rivets to $5 as against $4 per 100 lb. last week. Shapes and bars, $2@$2.25 f.o.b. Pittsburgh, on ordinary business, for indefinite deliveries; $2.50 per 100 lb. quoted on structurals, however, where deliveries are specified at earliest possible time consistent with rail embargoes, now holding up all but food and fuel shipments. Railroads doing the bulk of steel buying; 113,000 cars, purchased thus far this year as against 28,000, last year.

Connellsville foundry coke up 50c. per ton. Advance of 50c. per ton in No. 2 foundry pig iron at Birmingham and the same on basic at Pittsburgh. Following rise in pig iron comes the quotation of $48.70, as against $46.86, on 6-in. c.i. pipe in Chicago; $54, advanced from $53, in Seattle; $55.50, up from $52, in Minneapolis, and $55 as compared with $50 per ton in Montreal.

Structural timbers, long-leaf yellow pine, up $2 in Chicago; Douglas fir advanced $1 in Minneapolis and $2 per M ft. b.m. in San Francisco.

With slight improvement in the fuel situation and a seasonal slackening in demand, common brick quotations are now at $15@$16 wholesale, alongside dock New York, as against $15@$17 per M, last week.

Common lump lime, however, rose 5c. per bbl. in Atlanta and hollow tile advanced $11.80 per M in New York.

Raw linseed oil up 2c. in New York; down 2c. in Atlanta, 4c. in Denver and 6c. per gal. in Montreal.